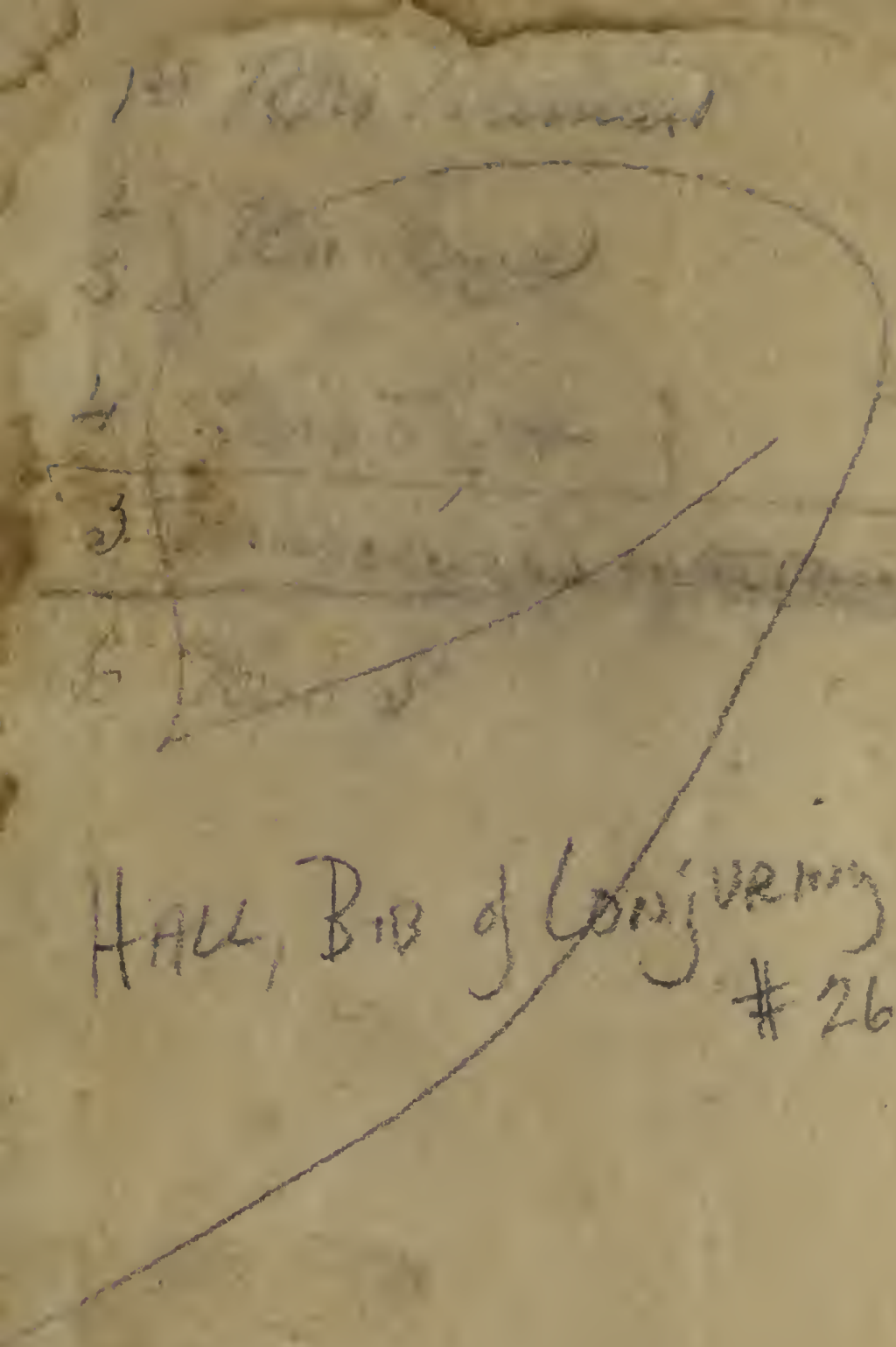

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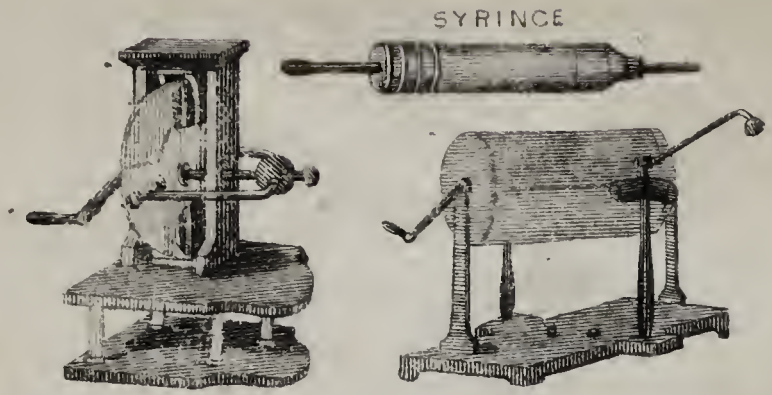

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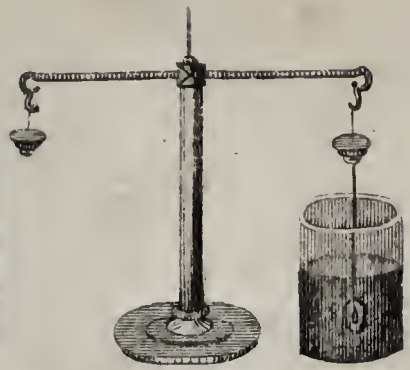

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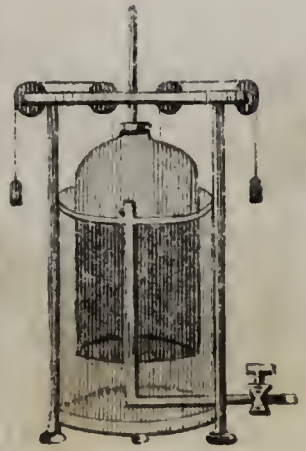

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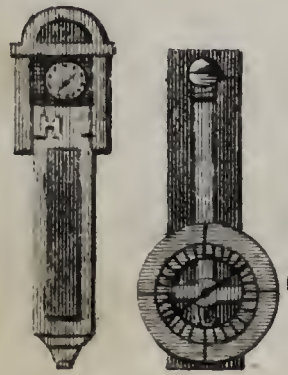

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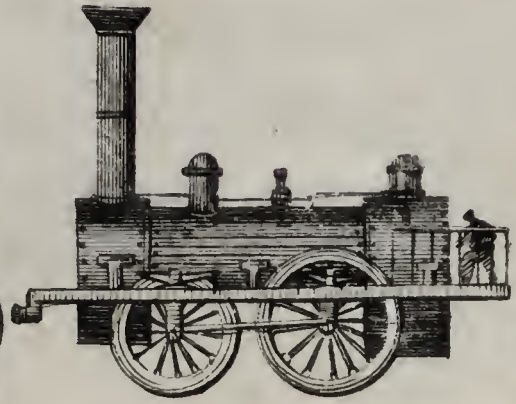

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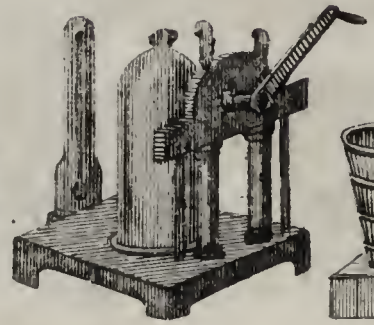

AIR PUMP

STILL

THE MODERN
CABINET OF ARTS;

A SERIES OF

ENTERTAINING EXPERIMENTS

IN

VARIOUS BRANCHES OF SCIENCE;

NUMEROUS VALUABLE RECIPES,

AND

USEFUL FACTS;

COMPILED FROM AUTHENTIC SOURCES.

SECOND EDITION.

BY T. C. THORNTON.

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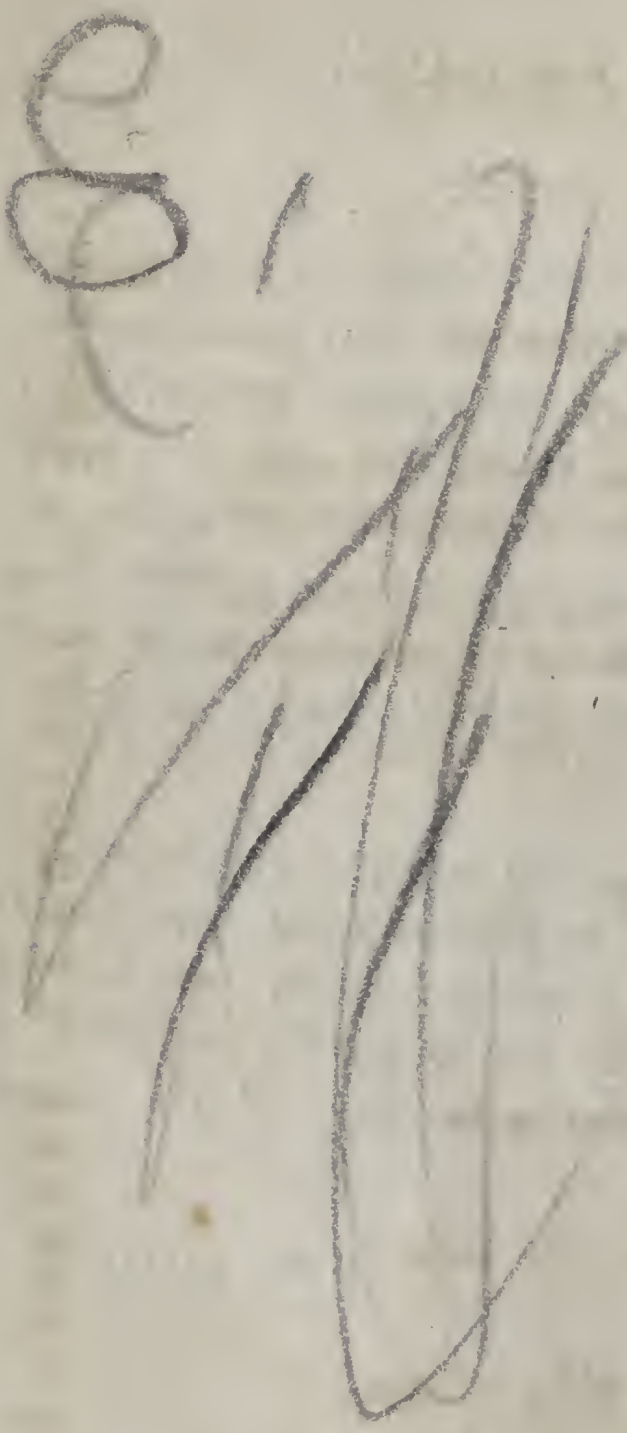
PREFACE.

In compiling the present volume, our object has been to bring under view the most interesting experiments, useful arts, and valuable recipes, which inventive individuals, in different ages, have made known. We have endeavoured to illustrate the processes in various useful arts and manufactures, and collect from authentic sources explanations of those scientific deceptions which have excited general admiration.

From the number and variety of objects presented to our senses by chemistry and experimental philosophy, these pleasing sciences have become increasingly popular, and we promise our readers a fund of amusement in the pages of the present work.

THE AUTHOR.

London, 1842.



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THE

CABINET OF ARTS.

ON THE NATURE OF THE DIAMOND.

The diamond is not more an object of attention to the jeweller than to the chemist; for it is as singular in its composition among the chrystals, as it is valuable, on account of its rarity and lustre, among the gems; having of late been fully ascertained to consist of nothing more than pure charcoal under a peculiar state of chrystallisation.

Upon this subject we shall copy Mr. Smithson Tennant's interesting paper, as communicated to the Royal Society.

Sir Isaac Newton having observed that inflammable bodies had a greater refraction, in proportion to their density, than other bodies, and that the diamond resembled them in this property, was induced to conjecture that the diamond itself was of an inflammable nature. The inflammable substances which he employed were camphire, oil of turpentine, oil of olives, and amber; these he called "fat, unc-

tuous, sulphureous bodies;" and using the same expression respecting the diamond, he says, it is probably "an unctuous body coagulated." This remarkable conjecture of Sir Isaac Newton has been since confirmed by repeated experiments. It was found, that though the diamond was capable of resisting the effects of a violent heat when the air was carefully excluded, yet that on being exposed to the action of heat and air, it might be entirely consumed. But as the sole object of these experiments was to ascertain the inflammable nature of the diamond, no attention was paid to the products afforded by its combustion; and it still therefore remained to be determined whether the diamond was a distinct substance, or one of the known inflammable bodies. Nor was any attempt made to decide the question till M. Lavoisier undertook a series of experiments for this purpose. He exposed the diamond to a heat produced by a large lens, and was thus enabled to burn it in close glass vessels. He observed that the air in which the inflammation had taken place had become partly soluble in water, and precipitated from lime water a white powder which appeared to be chalk, being soluble in acids with effervescence. As M. Lavoisier seems to have had little doubt that this precipitation was occasioned by the production of fixed air, similar to that which is afforded by calcareous substances, he might, as we know at present, have inferred that the diamond contained charcoal; but the relation between that substance and fixed air, was then too imperfectly understood to justify this conclusion. Though he observed the resemblance of charcoal to the diamond, yet he thought that nothing more could be

reasonably deduced from their analogy, than that each of these substances belonged to the class of inflammable bodies.

As the nature of the diamond is so extremely singular, it seemed deserving of further examination; and it will appear from the following experiments, that it consists entirely of charcoal differing from the usual state of that substance only by its crystallised form. From the extreme hardness of the diamond, a stronger degree of heat is required to inflame it, when exposed merely to air, than can easily be applied in close vessels, except by means of a strong burning lens; but with nitre its combustion may be effected in a modern heat. To expose it to the action of heated nitre free from extraneous matters, a gold tube was procured, which by having one end closed might serve the purpose of a retort, a glass tube being adapted to the open end for collecting the air produced. To be certain that the gold vessel was perfectly closed, and that it did not contain any unperceived impurities which could occasion the production of fixed air, some nitre was heated in it till it became alkaline, and afterwards dissolved out by water; but the solution was perfectly free from fixed air, as it did not affect the transparency of lime water. When the diamond was destroyed in the gold vessel by nitre, the substance which remained precipitated lime from lime-water, and with acids afforded nitrous and fixed air; and it appeared solely to consist of nitre partly decomposed, and of ærated alkali.

In order to estimate the quantity of fixed air which might be obtained from a given weight of

diamonds, 2½ grs. of small diamonds were weighed with great accuracy, and being put into the tube with ¼ oz of nitre, were kept in a stroug red heat for about an hour and a half. The heat being gradually increased, the nitre was in some degree rendered alkaline before the diamond began to be inflamed, by which means almost all the fixed air was retained by the alkali of the nitre. The air which came over was produced by the decomposition of the nitre, and contained so little fixed air as to occasion only a very slight precipitation from lime-water. After the tube had cooled, the alkaline matter contained in it was dissolved in water, and the whole of the diamonds were found to have been destroyed. As an acid would disengage nitrous air from this solution as well as the fixed air, the quantity of the latter could not, in that manner, be accurately determined. To obviate this inconvenience, the fixed air was made to unite with calcareous earth, by pouring into the alkaline solution a sufficient quantity of a saturated solution of marble in marine acid. The vessel which contained them being closed, was left undisturbed till the precipitate had fallen to the bottom, the solution having been previously heated, that it might subside more perfectly. The clear liquor being found, by means of lime water, to be free from fixed air, was carefully poured off from the calcareous precipitate. The vessel used on this occasion was a glass globe, having a tube annexed to it, that the quantity of the fixed air might be more accurately measured. After as much quicksilver had been poured into the glass globe containing calcareous precipitate as was necessary to fill it, it was

inverted in a vessel of the same fluid. Some marine acid being then made to pass up into it, the fixed air was expelled from the calcareous earth; and in this experiment, in which 2½ grs. of diamonds had been employed, occupied the space of a little more than 10.1 oz. of water. The temperature of the room when the air was measured, was 55 deg., and the barometer stood at about 39,8 inches.

From another experiment made in a similar manner with 1½ grains of diamonds, the air obtained occupied the space of 6.11 oz. of water, according to which proportion the bulk of the fixed air 2½ grs. would have been equal to 10.3 oz.

The quantity of fixed air thus produced by the diamond, does not differ much from that which, according to M. Lavoisier, might be obtained from an equal weight of charcoal. In the Memoirs of the French Academy of Sciences, he has related the various experiments which he made to ascertain the proportion of charcoal and oxygen in fixed air. From those which he considered as most accurate, he concluded that one hundred parts of fixed air contain nearly twenty-eight parts of charcoal and seventy-two of oxygen. He estimates the weight of a cubic inch of fixed air, under the pressure and in the temperature above mentioned, to be .695 parts of a grain. If we reduce the French weights and measures to English, and then compute how much fixed air, according to this proportion, 2½ grs. of charcoal will produce, we shall find that it ought to occupy very nearly the bulk of ten ounces of water.

M. Lavoisier seems to have thought that the

aerial fluid produced by the combustion of the diamond was not so soluble in water as that procured from calcareous substances. From its resemblance however, in various properties, hardly any doubts remain that it consisted of the same ingredients; and I found, on combining it with lime, and exposing it to heat with phosphorus, that it afforded charcoal in the same manner as any other calcareous substance.

Since the above account, M. Guyton de Morveau having burnt the diamond in oxygen gas, by the solar rays, and thereby obtained carbonic acid without residue, presumed that he had ascertained the diamond to consist of pure carbon, or the pure principle of charcoal, that which yields the pure acidifiable basis of carbonic acid. But it was Clouet who proposed the conclusive experiment of making soft iron pass to the state of steel, by cementation with the diamond. To this end he secured a diamond with some filings of iron, in a cavity bored in a block of soft iron, filling up the cavity with a stopper of iron. The whole properly included in a crucible, was exposed to the heat of a blast furnace, by which the diamond disappeared, and the metal was fused, and converted into a small mass or bottom of cast steel.

THE RAINBOW.

The rainbow had from the earliest times been an object of admiration to every spectator; but it was long before any observer knew the full extent to which that admiration ought to be carried, or even cared to understand it. If it be unpardonable to

shut our eyes to the most glorious spectacles in nature, it is doubly so to close our mental vision against that more perfect and more intimate perception of them which the knowledge of their causes affords. Among those who felt any interest in such enquiries, the rainbow was generally understood to arise in some way from the light reflected by the drops of rain falling opposite to the sun. Maurolycus suggested that the light in passing through the drop, so as to be reflected through from its back, somehow acquires colour from the refraction; but he suggested no farther than this idea. Others made suggestions which only tended to perplex the matter. Antonio de Dominis, Archbishop of Spalatro, approached very nearly to the complete explanation. Having placed a globular bottle of water opposite to the sun, and above his eye, he saw coloured rays issue from the under side of the globe; the colours were different, according as it was more or less elevated, and in order of the rainbow. He correctly traced the course of the rays refracted at entering and quitting the water, and reflected at the back of it. The same would therefore hold good with a globular drop of water in a shower; and from the same angle being invariably required for each colour in a plane passing through the eye, the drop, and the sun, the circular form of the bow was accounted for. Still the actual origin or law of the connection between refraction and colour was totally unknown. The explanation, too, extended only to the primary or interior bow; in attempting that of the secondary the author failed. This investigation of De Dominis is the more remarkable, since he is not known for any other scientific discovery; he

published an account of it in a work, "De Radiis Visus et Lucis," in 1611. Yet the treatise is in some points so faulty that Roscovich calls him "homo opticarum rerum supra id quod patiatur ea ætas impertissimus" (a man ignorant of optics to a degree even beyond what that age would endure). This seems unduly severe upon a man who had been the first to propose an explanation so perfectly just and philosophical, as far as it went, of a very complex phenomenon: and if deficient in some points of detail, which was evinced in a freedom and independence of opinions on theological subjects, extraordinary to be avowed by a dignitary of the Romish Church, and which, as he had not the hypocrisy to disguise it, was, of course, heresy, and exposed him to a furious persecution. From this he found an asylum at the court of James I. of England, but returning to Italy, was imprisoned, where he died, and all his writings were condemned to the flames by the Inquisition.

THE PRESSURE OF WATER.

The pressure of water may be known to every one who will only take the trouble to look at the cock of a water butt when turned; if the tub or cistern be full, the water runs with much greater velocity through the cock, and a vessel will be filled from it in a shorter time than when it is only half full, although the cock, in both cases, is equally replete with the fluid during the time the vessel is filling. From this also is understood, how a hole or leak, near the keel of a ship, admits the water much quicker, and with greater violence, than one

of the same size near what the mariners call the water's edge.

INTERESTING EXPERIMENT FOR THE MICROSCOPE.

The embryo grain of wheat, at the time of blossoming, being carefully taken out of the husk, will be found to have a small downy tuft at its extremity, which, when viewed in a microscope, greatly resembles the branches of thorn; spreading archwise, in opposite directions. By expanding a few of the grains, and selecting the most perfect, a very pretty microscope object will be obtained for preservation.

CALCULATION OF THE MASS OF WATER CONTAINED IN THE SEA.

If we would have an idea of the enormous quantity of water which the sea contains, let us suppose a common and general depth to the ocean; by computing it at only 200 fathoms, or the tenth part of a mile, we shall see that there is sufficient water to cover the whole globe to the height of 503 feet of water; and if we were to reduce this water into a mass, we should find that it forms a globe of more than sixty miles diameter.

DIFFERENT DEGREES OF HEAT IMBIBED FROM THE SUN'S RAYS BY CLOTHS OF DIFFERENT COLOURS.

Walk but a quarter of an hour in your garden when the sun shines, with a part of your dress white, and a part black; then apply your hand to them alternately, and you will find a very great difference in their warmth. The black will be quite hot to the touch, and the white still cool.

Try to fire paper with a burning glass; if it be white, you will not easily burn it; but if you bring the focus to a black spot, or upon letters written or printed, the paper will immediately be on fire under the letters.

Thus, fullers and dyers find black cloths, of equal thickness with white ones, and hung out equally wet, dry in the sun much sooner than the white, being more readily heated by the sun's rays. It is the same before a fire, the heat of which sooner penetrates black stockings than white ones, and so is apt sooner to burn a man's shins. Also beer much sooner warms in a black mug, set before the fire, than in a white one, or in a bright silver tankard.

Take a number of little square pieces of cloth from a tailor's pattern-card, of various colours; say black, deep blue, lighter blue, green, purple, red, yellow, white and other colours, or shades of colours; lay them all out upon the snow in a bright sun-shiny morning; in a few hours, the black being warmed most by the sun, will be sunk so low as to

be below the stroke of the sun's rays; the dark blue almost as low; the lighter blue not quite so much as the dark; the other colours less, as they are lighter: and the white quite remain on the surface of the snow, as it will not have entered it at all.

ALTERFANE ILLUSION.

With a convex lens of about an inch focus, look attentively at a silver seal, on which a cypher is engraved. It will at first appear cut in, as to the naked eye: but if you continue to observe it some time, without changing your situation, it will seem to be in relief, and the lights and shades will appear the same as they did before. If you regard it with the same attention still longer, it will again appear to be engraved:—and so on alternately.

If you look at the seal for a few moments, when you view it again, instead of seeing it, as at first, engraved, it will appear in relief.

If, while you are turned towards the light, you suddenly incline the seal, while you continue to regard it, those parts that seemed to be engraved will immediately appear in relief: and if, when you are regarding these seemingly prominent parts, you turn yourself so that the light may fall on the right hand, you will see the shadows on the same side from whence the light comes, which will appear not a little extraordinary. In the like manner the shadows will appear on the left, if the light fall on that side. If instead of a seal you look at a piece of money, these alterations will not be visible, in whatever situation you place yourself.

THE CANDLE LIGHTED BY ELECTRICITY.

Charge a small coated phial, whose knob is bent outwards so as to hang a little over the body of the phial; then wrap some loose cotton over the extremity of long brass pin or wire, so as to stick moderately fast to its substance. Next roll this extremity of the pin, which is wrapped up in cotton, in some fine powdered resin; then apply the extremity of the pin or wire to the external coating of the charged phial, and bring as quickly as possible the other extremity, that is wrapped round with cotton, to the knob; the powdered resin takes fire, and communicates its flame to the cotton, and both together burn long enough to light a candle.

Dipping the cotton in oil of turpentine will do as well, if you use a large sized jar.

CANDLE BOMBS.

Procure some small glass bubbles, having a neck about an inch long, with very slender bores, by means of which a small quantity of water is introduced into them, and the orifice afterwards closed up. This stalk being put through the wick of a burning candle, the flame boils the water into a steam, and the glass is broken with a loud explosion.

AUTOMATONS.

As automatons have been the favourite objects of mechanical contrivance from an early period, some account of these wonderful mechanical imitations, which have, at various times, amused and astonished the world, cannot fail to be interesting to our readers.

The celebrated story of the statue of Memnon (one of the wonders of Ancient Egypt,) has some pretensions to lead the way in this historical sketch. We have positive testimony to the circumstance of the most beautiful sounds being emitted from this statue, at the rising and setting of the sun; and from the pedestal after the statue was overthrown. What was the contrivance in this case, it may be vain to conjecture; but automata are, by profession, a puzzling race. If a certain disposition of strings, by exposure, to the rarefaction of the air, or to the morning and evening breezes, after the manner of our Æolian harps, produced these sounds; or if any method of arranging the internal apertures so as to receive them from a short distance, were the artifice, a considerable acquaintance with the science of music, and with acoustics generally will be argued. Wilkins quotes a musical invention of Cornelius Dreble, of similar pretensions, which "being set in the sunshine, would, of itself, render a soft and pleasing harmony, but being removed into the shade, would presently become silent."

Archytas' flying dove is another of the ancient automata. The inventor is said to have flourished about B. C. 400, and was a Pythagorean philosopher

at Tarentum. It was made of wood, and the principal circumstance of its history is that, like some other birds of too much wing, when it alighted on the ground, it could not raise itself up again. Aulus Gellius, in his Noctes Atticæ, attempts to account for its flight, by observing, that it was suspended by balancing, and moved by a secretly inclosed aura, or spirit.

Friar Bacon, we all know, made a brazen head that could speak, and that seems to have assisted in no small degree, in proclaiming him a magician. Albertus Magnus is also said to have devoted thirty years of his life to the construction of an automaton, which the celebrated Thomas Aquinas broke purposely to pieces. It will not create surprise, treated as these were by the age in which they lived, they had no encouragement to hope that any details of their labours would reach posterity.

Among the curiosities of his day, Walchius mentions an iron spider of great ingenuity. Its size did not exceed the ordinary inhabitants of our houses, and could creep or climb with any of them, wanting none of their powers, except, of which nothing is said, the formation of the web. Various writers of credit relate, that the celebrated John Muller, of Nuremberg, ventured a loftier flight of art. He is said to have constructed a self-moving wooden eagle, which descended towards the Emperor Maximilian, as he approached the gates of Nuremburg, saluted him, and hovered over his person as he entered the town. This philosopher, according to the same authorities, also produced an iron fly, which would start from his hand at table, and after flying round

to each of the guests, return, as if wearied, to the protection of his master.

An hydraulic clock, presented to the Emperor Charlemagne, by the Caliph Haroun Alraschid, merits record in the history of these inventions. It excited the admiration of all Europe at the period of its arrival. Twelve small doors divided the dial into twelve hours, and opened successively as each hour arrived, when a ball fell from the aperture on a brazen bell, and struck the time, the door remaining open. At the conclusion of every twelve hours, twelve mounted knights, handsomely caparisoned, came out simultaneously from the dial, rode round the plate, and closed the doors. Dr. Clarke, in his last volume of travels, mentions a similar contrivance in a clock at Lubeck, of the high antiquity of 1405. Over the face is an image of Jesus Christ, on either side of which are folding doors, which fly open every day as the clock strikes twelve. A set of figures, representing the twelve apostles, then march forth on the left hand, and bowing to our saviour's image as they pass in succession, enter the door on the right. On the termination of the procession, the doors close. This clock is also remarkably complete (for the age) in its astronomical apparatus; representing the place of the sun and moon in the ecliptic, the moon's age, &c.

Similar appendages to time pieces became too common at the beginning of the last century to deserve particular notice. We should not, however, omit some productions of the Le Droz family of Neufchatel. About the middle of the century, the elder Le Drox presented a clock to the King of Spain, with a sheep and a dog attached to it. The

bleating of the former was admirably correct, as an imitation; and the dog was placed in custody of a basket of loose fruit. If any one removed the fruit, he would growl, snarl, and gnash his teeth, and endeavour to bite till it was restored.

The son of this artist was the original inventor of the musical boxes, which have of late been imported into this country. Mr. Collison, a correspondent of Dr. Hutton's, thus clearly describes this fascinating toy in a letter to the Doctor, inserted in his Mathematical and Philosophical Dictionary.

"When at Geneva," observes this writer, I called upon Droz, the son of the original Droz, of La Chaux de Fords (where I also went.) He showed me an oval gold snuff-box, about, if I recollect right, four inches and a half long by three inches broad, an inch and a half thick. It was double, having an horizontal partition; so that it may be considered as one box placed on another, with a lid of course to each box. One contained snuff; in the other, as soon as the lid was opened, there rose up a very small bird, of green enamelled gold, sitting upon a gold stand. Immediately this minute curiosity wagged its tail, shook its wings, opened its bill of white enamelled gold, and poured forth, minute as it was (being only three-quarters of an inch from the beak to the extremity of the tail) such a clear melodious song as would have filled a room of twenty or thirty feet square with its harmony.

In Ozanam's Mathematical Recreations, we have an account, by the inventor, M. Camus, of an elegant amusement of Louis XIX. when a boy. It represented a lady proceeding to court, in a small

chariot drawn by two horses, and attended by her coachman, footman, and page. When the machine was placed at the end of a table of proper size, the coachman smacked his whip, the horses started off with all the natural motions, and the whole equipage drove on to the farther extremity of the table; it would now turn at right angles in a regular way, and proceed to that part of the table opposite to which the prince sat, when the carriage stopped, the page alighted to open the door, and the lady came out with a petition, which she presented with a curtsey to the bowing young monarch. The return was equally in order. After appearing to await the pleasure of the prince for a short time, the lady curtsied again and re-entered the chariot, the page mounted behind, the coachman flourished his whip, and the footman, after running a few steps. resumed his place.

M. Vaucanson, a member of the Academie Royale of France, led the way to the unquestionable superiority of modern times, in these contrivances, by the construction of his automation duck, a production, it is said, so exactly resembling the living animal, that not a bone of the body, and hardly a feather of the wings, seems to have escaped his imitation and direction. The radius, the cubitus, and the humerus, had each their exact offices. The automaton ate, drank, quacked in perfect harmony with nature. It gobbled food brought before it with avidity, drank, and even muddied the water after the manner of the living bird.

Ingenious contemporaries of the inventor, who solved all the rest of his contrivances, could never wholly comprehend the mechanism of this duck. A

chemical solution of the food was contrived to imitate the effect of digestion.

This gentleman is also celebrated for having exhibited at Paris, in 1738, an automaton flute player, whose powers exceeded all his ancestry; and for the liberality and good sense with which he communicated to the Academy, in the same year, an exact account of its construction.

The figure was nearly six feet in height, and usually placed on a square pedestal four feet and a half high, and about three and a half broad. The air entered the body by three separate pipes, into which it was conveyed by nine pair of bellows, which were expanded and contracted at pleasure, by means of an axis formed of metallic substances, and which was turned by the aid of clock-work. There was not even the slightest noise heard during the operations of the bellows: which might otherwise have discovered the process, by which the air was conveyed ad libitum into the body of the machine. The three tubes into which the air was sent by means of the bellows, passed again into three small reservoirs concealed in the body of the automaton. After having united in this place, and ascended towards the throat, they formed the cavity of the mouth, which terminated in two small lips, adapted to the performance of their respective functions. A small moveable tongue was inclosed within this cavity, which admitted or intercepted the passage of the air in the flute, according to the tune that was executed, or the quantity of wind that was requisite for the performance. A particular species of steel cylinder, which was turned by means of clock-work, afforded the proper movements to the fingers, lips,

and tongue. This cylinder was divided into fifteen equal parts, which caused the ascension of the other extremities; by the aid of pegs, which pressed upon the ends of fifteen different levers. The fingers of the automaton were directed in their movements by seven of these levers, which had wires and chains attached to their ascending extremities; these being fixed to the fingers, caused their ascension in due proportion to the declension of the other extremity, by the motion of the cylinder: and thus, on the contrary, the ascent, or descent, of one end of the lever, produced a similar ascent, in the fingers, that corresponded to the others; by which one of the holes was opened or stopped agreeable to the direction of four levers: one of which opened them in order to give the air a freer passage: the other contracted them; the third drew them back; and, by the different motions which have been already enumerated, regulated the tune in the requisite manner for execution. The direction of the tongue furnished employment for the remaining lever, which it moved in order that it might be enabled to shut or open the mouth of the flute.

The extremity of the axis of the cylinder was terminated on the right side by an endless screw, consisting of twelve threads, each of which was placed at the distance of a line and a half from the other. A piece of copper was fixed above this screw; and within it was a steel pivot, which was inserted between the threads of the screw, and obliged the cylinder above mentioned to pursue the threads. Thus instead of moving in a direct turn, it was perpetually pushed to one side; the

successive elevation of the levers displaying all the different movements of a professed musician.

The same artist constructed another celebrated automaton, which played on the Provencal shepherd's pipe, and beat, at the same time, on an instrument called the tambour de basque. This was also a machine of the first order, for ingenious and difficult contrivance. The shepherd bore the flageolet in his left hand, and in the right a stick, with which he beat the tabor, or tambourine, in accompaniment. He was capable of playing about twenty different airs, consisting of minuets, rigadoons, and country dances. The pipe, or flageolet, which he was made to play, is a wind instrument of great variety, rapidity, and power of execution, when the notes were well filled and properly articulated by the tongue : but it consists only of three holes, and the execution, therefore, mainly depends upon the manner in which they are covered, and the due variation of the force of the wind that reaches them.

To give the automatons power to sound the highest note, M. Vaucanson found it necessary to load the bellows, which supplied the air to this tone, with fifty six pounds weight, while that of one ounce supplied the lowest tone. Nor was the same note always to be executed by exactly the same force of air ; it was necessary to pay the most accurate attention to its place on the scale, and to so many difficult circumstances of combination and expression that the inventor often declares himself to have been frequently on the point of relinquishing his attempt in its progress. In the tambourine accompaniment, too, there were numerous obstacles to overcome ; the variations of the stroke,

and particularly the continued roll of this instrument, was found to require no small ingenuity of construction.

All other exhibitions of mechanical skill, in imitation of the powers of human nature, were destined however, to give way, in 1769, to the pretensions of the chess player of M. Wolffgang de Kempelin, an Hungarian gentleman, and Aulic Councellor of the Royal Chamber of the domains of the Emperor of Hungary.

Called in that year to Vienna by the duties of his station, this gentleman was present at some experiments on magnetism made before the Empress, Maria Theresa, when he ventured to hint, that he could construct, for her Majesty, a piece of mechanism far superior to any of those which had been exhibited. His manner of remarking this, excited the attention of the Empress, who, encouraging him to make the effort, the automaton chess-player, which has since been exhibited in all the capitals of Europe, was, within six months after this period, presented at the imperial court. It is a presumption in favour of the pretensions of this contrivance to be a masterpiece of mere mechanism, that the original artist, after having gratified his exalted patroness and her court with the exhibition of it, appeared for many years indifferent to its fame. He engaged himself in other mechanical pursuits with equal ardour, and is said to have so far neglected this, as to have taken it partly to pieces, for the purpose of making other experiments. But the visit of the Russian Grand duke Paul to the court of Joseph II. again called our automaton to life. It was repaired and put in order in a few

weeks; and, from this period, (1785) has been exhibited, at intervals, throughout Germany, at Paris, and in London; first by M. de Kempelin, and latterly by a purchaser of the property from his son; de Kempelin having died in 1803.

THE ART OF BRONZING.

Bronzing is that process by which figures of plaster-of-Paris, wood, &c. are made to have the appearance of copper or brass. The method is as follows:

Dissolve copper filings in aqua fortis. When the copper has impregnated the acid, pour off the solution, and put into it some pieces of iron, or iron filings. The effect of this will be to sink the powder to the bottom of the acid. Pour off the liquor, and wash the powder in successive quantities of fresh water. When the powder is dry, it is to be rubbed on the figure with a soft cloth, or piece of leather: but observe, that previously to the application of the bronze powder, a dark blackish sort of green is first to be laid on the figure; and if you wish the powder to adhere stronger, mix it with gum water, lay it on like paint, with a camel's hair brush, or previously trace the parts to be bronzed with gold size, and when nearly dry, rub the powder over it.

TO SOFTEN HORN.

To one pound of wood-ashes, add two pounds of quick lime; put them into a quart of water. Let the whole boil till reduced to one third. Then dip

a feather in, and if on drawing it out, the plume should come off, it is a proof that it is boiled enough, if not, let it boil a little longer. When it is settled, filter it off, and in the liquor thus strained put in shavings of horn. Let them soak for three days: and, first anointing your hands with oil, work the horn into a mass, and print or mould it into any shape you please.

ALARUM.

Against the wall of a room, near the ceiling, fix a wheel of twelve or eighteen inches in diameter; on the rim of which place a number of bells in tune, and, if you please, of different sizes. To the axis of this wheel there should be fixed a fly to regulate its motion; and round the circumference there must be wound a rope, to the end of which is hung a weight.

Near to the wheel let a stand be fixed, on which is an upright piece that holds a balance or moveable lever, on one end of which rests the weight just mentioned, and to the other end must hang an inverted hollow cone, or funnel, the aperture of which is very small. This cone must be graduated on the inside, that the sand put in may answer to the number of hours it is to run. Against the upright piece, on the side next the cone, there must be fixed a check, to prevent it from descending. This stand, together with the wheel, may be inclosed in a case, and so contrived, as to be moved from one room to another with very little trouble.

It is evident, from the construction of this machine, that when a certain quantity of sand is run

out, the weight descends, and puts the wheel in motion, which motion will continue till the weight comes to the ground. If the wheel be required to continue longer in motion, two or more pullies may be added, over which the rope may run.

TO MAKE TOUCH PAPER.

Dissolve in some spirits of wine or vinegar, a little saltpetre; then take some purple or blue paper, wet it with the above liquor, and when dry it will be fit for use. When you paste this paper on any of your works, take care that the paste does not touch that part which is to burn. The method of using this paper is, by cutting it into slips, long enough to go once round the mouth of the serpent, cracker, &c. When you paste on these slips, leave a little above the mouth of the case not pasted; then prime the case with meal powder, and twist the paper to a point.

TO MAKE CRACKERS.

Cut some stout cartridge-paper in pieces three inches and a half broad, and one foot long: one edge of each of three pieces fold down lengthwise about three quarters of an inch broad; then fold the double edge down a quarter of an inch, and turn the single edge back half over the double fold: open it, and lay all along the channel, which is formed by the foldings of the paper, some meal powder; then fold it over and over till all the paper is doubled up, rubbing it down at every turn: this being done, bend it backwards and forwards, two inches and a

half, or thereabouts, at a time, as often as the paper will allow; hold all these folds flat and closed, and with a small pinching cord, give one turn round the middle of the cracker, and pinch it close; bind, it with packthread, as tight as you can; then in the place where it was pinched, prime one end, and cap it with touch paper. When these crackers are fired, they will give a report at every turn of the paper; if you will have a great number of bounces, you must cut the paper longer, or join them after they are made: but if they are made very long before they are pinched, you must have a piece of wood with a groove in it, deep enough to let in half the cracker; this will hold it straight while it is pinching.

TO MAKE SQUIBS AND SERPENTS.

First make the cases, about six inches in length, by rolling slips of stout cartridge paper about three times round a roller, and pasting the last fold; tying it near the bottom as tight as possible, and making it air tight at the end by sealing-wax. Then take of gunpowder half a pound, charcoal one ounce, brimstone one ounce, and steal-filings half an ounce, (or in like proportion) grind them with a muller, or pound them in a mortar. Your cases being dry and ready, first put a thimble full of your powder, and ram it hard down with a ruler; then fill the case to the top with the aforesaid mixture, ramming it hard down in the course of filling two or three times; when this is done, point it with touch paper, which should be pasted on that part

which touches the case, otherwise it is liable to drop off.

SKY ROCKETS.

Rockets being of the fire-works most in use, we shall give them the preference in description. As the performance of rockets depends much upon their moulds, they should be made according to the following proportions :—Taking the diameter of the orifice, its height should be equal to six diameters and two-thirds; the choke, one diameter and one-third of this model, will serve for every rocket from four ounces to six pounds. For instance; suppose the diameter of a rocket of 1lb. be $1\frac{1}{2}$ inch, then its length being 6 diameters and two-thirds, the length of the case must be $10\frac{1}{2}$ inches, and the choke $2\frac{1}{4}$ inches. Your rammer must have a collar of brass to prevent the wood from splitting.

METHOD OF ROLLING ROCKET CASES.—The cases must be made of the strongest cartridge paper, and rolled up dry. The case of a middling sized rocket will take up paper of four or five inches thick; having cut your paper to a proper size, and the last sheet with a slope at one end, fold down one end, and lay your former on the double edge, and when you have rolled on the paper within two or three turns, lay the next sheet on that part which is loose, and roll it all on. Then, in order to roll the case as hard as possible, place it on a table, and with a smooth board roll it for some time forwards on the table till it becomes quite hard and firm. This must be done with every sheet. You have next to choak the case, for which purpose draw your former a little distance

from the bottom, then, with a cord once round the case, pull it rather easy at first, and harder, till you have closed the end. To make it easy, you may dip the ends of the inner sheets in water before rolling, then bind it with small twine.

Having thus pinched and tied the case so as not to give way, put into the mould without its foot, and with a mallet drive the former hard on the end-piece, which will force the neck close and smooth. This done, cut the case to its proper length, allowing from the neck to the edge of the mouth half a diameter, which is equal to the height of the nipple, then take out the former, and drive the case over the piercer with a long rammer, and the vent will be of a proper size.

Having formed your cases, we will now proceed to the description of the ingredients necessary for the rocket.

Of mixing the composition.—The performance of the principal parts of fire-works depends much on the compositions being well mixed, therefore, great care must be taken in this part of the work, particularly for the composition of sky-rockets. When you have four or five pounds of ingredients to mix, which is a sufficient quantity at a time, for a larger proportion will not do so well, first put the different ingredients together, then work them about with your hands, till you think they are pretty well incorporated; after which put them into a lawn sieve with a receiver and top to it; and if, after it is sifted, any remains that will not pass through the sieve, grind it again till it is fine enough; and if it be twice sifted, it will not be amiss, but the composition for wheels and common works is not so material,

nor need be so fine. But in all fixed works, from which the fire is to play regular, the ingredients must be very fine, and great care taking in mixing them well together; and observe, that in all compositions wherein are iron filings, the hand must not touch them; nor will any works which have either iron or steel in their charge keep long in damp weather.

To DRIVE OR RAM ROCKETS.—Rockets are filled hollow, otherwise they would not ascend, and there is not a part that requires greater attention than this stage of the process. One blow more or less with the mallet will spoil the ascent.

The charge of rockets must always be driven above the piercer, and on it must be rammed a thin head of clay; through the middle of which bore a small hole to the composition, that when the charge is burnt to the top, it may communicate its fire through the hole to the stars in the head.

To a rocket of four ounces, give to each ladle-full of charge 16 strokes; to a rocket of 1 pound, 28; to a 2-pounder, 36; to a 4-pounder, 42; and to a 6-pounder, 56; but rockets of a larger sort cannot be driven well by hand, but must be rammed with a machine made in the same manner as those for driving piles.

The method of ramming wheel cases, or any other sort in which the charge is driven solid, is the same as the sky rocket.

When you load the heads of your rockets with stars, rains, serpents, crackers, scrolls, or any thing else, according to your fancy, remember always to put a ladleful of meal powder into each head, which

will be enough to burst the head, and disperse the stars, or whatever it contains.

DECORATIONS FOR SKY ROCKETS.—Sky rockets may be decorated according to fancy. Some are headed with stars of different sorts, such as tailed, brilliant, white, blue, and yellow stars, &c. Some with gold and silver rains: others with serpents, crackers, fire-scrolls, and maroons; and some with small rockets and other devices, as the maker pleases.

LENGTH OF ROCKET STICKS.

	lb.	oz.		ft.	in.	
For rockets of	6	0	the stick must be	14	10	long
	4	0	.....	12	10	
	2	0	.....	9	4	
	1	3	.....	8	2	
	0	8	.....	6	6	
	0	4	.....	5	3	

Having your sticks ready, cut on one of the flat sides of the top a groove the length of the rocket, and as broad as the stick will allow; then on the opposite flat side, cut two notches, for the cord, which ties on the rocket, to lie in; one of those notches must be near the top of the stick, and the other facing the neck of the rocket: the distance between the notches may easily be known, for the top of the stick should always touch the head of the rocket. When your rockets and sticks are ready, lay the rockets in the grooves in the sticks, and tie them on. We will now proceed to the charge for sky rockets:—

ROCKETS OF FOUR OUNCES.

	lb.	oz.		lb.	oz.
Meal-powder	1	4	Charcoal	0	2
Saltpetre	0	4			

SKY ROCKETS IN GENERAL.

	lb.	oz.		lb.	oz.
Saltpetre	4	0	Charcoal	1	12
Brimstone	1½	0	Meal-powder	0	2

BRILLIANT ROCKET STARS.

	lb.	oz.		lb.	oz.
Saltpetre	0	3½	Meal-powder	0	0¾
Sulphur	0	1½			

Worked up with spirits of wine only.

CHINESE FOUNTAINS.

To make a Chinese fountain, you must have a perpendicular piece of wood seven feet long and two inches and a half square. Sixteen inches from the top, fix on the front a cross piece one inch thick, and two and a half broad, with the broad side upwards: below this fix three or more pieces of the same width and thickness, at sixteen inches from each other; let the bottom rail be five feet long, and the others of such a length as to allow the fire-pumps to stand in the middle of the intervals of each other. The pyramid being thus made, fix in the holes made in the bottom rail five fire pumps, at equal distances; on the second rail, place four

pumps; on the third, three; on the fourth, two; and on the top of the post, one; but place them all to incline a little forward, that, when they throw out the stars, they may not strike against the cross rails. Having fixed your fire-pumps, clothe them with leaders, so that they may be all fired together.

TO FIRE SKY ROCKETS UNDER WATER.

You must have stands made as usual, only the rails must be placed flat instead of edgewise, and have holes in them for the rocket sticks to go through; for if they were hung upon hooks, the motion of the water would throw them off; the stands being made, if the pond is deep enough, sink them at the sides so deep, that, when the rockets are in, their heads may just appear above the surface of the water; to the mouth of each rocket fix a leader, which put through the hole with the stick; then a little above the water must be a board supported by the stand, and placed along one side of the rockets: then the ends of the leaders are turned up through holes made in the board, exactly opposite the rockets. By this means you may fire them singly, or all at once. Rockets may be fired by this method in the middle of a pond, by a Neptune, a swan, a water-wheel, or any thing else you choose.

INVISIBLE INK.

Put lithrage of lead into very strong vinegar, and let it stand about twenty-four hours. Strain it off,

and let it remain till quite settled; then put the liquor into a bottle.

You next dissolve orpiment in quick lime water, by setting the water in the sun for two or three days, turning it five or six times a day. Keep the bottle containing this liquor well corked, as the vapour is highly pernicious if it be received into the mouth.

Write what you wish with a pen dipped in the first liquor; and to make it visible, expose it to the vapour of the second liquor. If you wish them to disappear again, draw a sponge or pencil, dipped in aquafortis, or the spirit of nitre, over the paper; and if you wish them to re-appear, let the paper be quite dry, and then pass the solution of orpiment over it.

INVISIBLE RED INK.

To the pure spirit of vitriol or nitre, add eight times as much water.

To make the characters visible, which you write with this ink, pass a sponge over the paper, dipped in the following solution:—

Take a quantity of flowers of pansy, or the common violet, bruise them in a mortar with water, strain the liquor in a cloth, and keep it in a bottle.

TO REMOVE STAINS AND BLEMISHES FROM PRINTS.

Paste a piece of paper to a very smooth clear table, that the boiling water, used in the operation, may not acquire a colour which might lessen its

success. Spread out the print you wish to clean upon the table, sprinkle it with boiling water; taking care to moisten it throughout by very carefully applying a very fine sponge. After you have repeated this process five or six times, you will then observe the stains or spots extend themselves: but this is only a proof that the dirt begins to be dissolved.

After this preparation, lay the print smoothly and carefully into a copper or wooden vessel, larger than the size of the print. Then cover it with a boiling ley of potash, taking care to keep it hot as long as possible. After the whole is cooled, strain off the liquor, take out the print with care, spread it on a stretched cord, and when half dry, press it between leaves of white paper to prevent wrinkles.

By this process, spots and stains of any kind will be effectually removed.

THE ÆOLIAN HARP.

This elegant little musical instruments, is very easily constructed. Provide a long narrow box of thin deal, about thirty inches long, five inches broad, and one inch and three-fourths deep, with a circle in the middle of the upper side or belly about an inch and a half in diameter, pierced with small holes. Along this upper side of the box are seven, ten, or more strings of very fine gut, stretched over bridges at each end, like the bridge of a fiddle, and screwed up or relaxed with screwpins. If this instrument is placed in a current of air, where the wind can brush over its strings with freedom,—as at a window, with the sash just raised,

to give the air admission, there will be produced a kind of wild melancholy music, extremely charming to hear: the blast sometimes bringing out all the tones in full chorus; and at others sinking them to the softest murmurs.

THE SECRET OF THE FIRE-EATING ART.

The following statement is from that authentic record of facts, the Gentleman's Magazine. The secret of fire eating consists only in rubbing the hands, and thoroughly washing the mouth, lips, tongue, teeth, and other parts that are to touch the fire, with pure spirit of sulphur. This burns and cauterizes the epidermis, or upper skin, till it becomes as hard as thick leather, and every time the experiment is tried it becomes still easier than before. But if, after it has been very often repeated, the upper skin should grow so callous and horny as to become troublesome, washing the parts affected with very warm water, or hot wine, will bring away all the shrivelled or parched epidermis. The flesh however will continue tender and unfit for such business, till it has been frequently rubbed over again with the same spirit.

This preparative may be rendered much stronger and more efficacious, by mixing equal quantities of spirit of sulphur, sal ammoniac, essence of rosemary, and juice of onions. The spirit of sulphur is made by adding very gradually an ounce and a half, by measure, of sulphuric acid to fourteen and a half ounces of distilled water.

The bad effects which the frequent swallowing of red hot coals, melted sealing wax, rosin, brim-

stone, and other calcined and inflammable matters, might have upon the stomach, are prevented by the fire-eater's drinking plentifully of warm water and oil, as soon as he leaves the company, till he has vomited all up again. Whoever is acquainted with this secret, may safely walk over burning coals, or red hot plough-shares, as Queen Emma is said to have done.

MAGNETIC EXPERIMENTS.

1. If you present to a piece of iron, either the north or south pole of a magnetic, the iron will be attracted; but if you present the middle of the magnet to the iron, the iron will not be attracted. This shows that the two poles of the magnet counteract each other's influence.

2. If you place a small magnet on a piece of cork, and a piece of iron on another piece of cork, and let the two float in a basin of water; you will find that the attraction between the iron and the magnet is mutual, or that the magnet moves towards the iron, as much as the iron towards the magnet.

3. You will find that the interposition of paper, wood, glass, or any other substance, excepting iron and bodies containing it, between two magnets, does not in the least degree diminish the powers either of attraction or repulsion.

4. Take two pieces of soft iron wire, and tie to each the extremity of a piece of thread; hang the thread by the middle over a hook, so that the pieces of iron may hang down side by side, and apply to the latter the north pole of a magnet, the pieces of

iron will then be repelled upon each other, and will stand apart like two legs of a pair of compasses when open. This experiment is analogous to that of placing an electrified rod near a pair of suspended with balls.

5. If you have a natural magnet of an irregular shape, and wish to find in which part of it the two poles are situated, immerse it in a quantity of iron filings; upon taking it out, you will find it covered over with them, but there will be two places diametrically opposite to each other, which are the poles, where the filings are closer, and where the small oblong fragments stand as it were upright, while in other parts they lie flat. A line drawn from one pole of a magnet to the other, is called the axis of the magnet.

6. Place a magnet upon a piece of pasteboard, and strew some iron filings about it: if you then glue the pasteboard a few gentle taps, so as to take the filings, you will see them range themselves round the magnet in curved lines, which approach each other like the meridian lines in a map of the world, and meet at the two poles. This remarkable experiment favours the opinion of those who think that the magnetic phenomena are owing to a peculiar fluid, which issues from one of the poles of the magnet, and enters at the other, after having circulated in a certain sphere round it. This fluid is said to be the thing which gives to magnets their attractives and repulsive properties. In this experiment, every little particle of iron near the magnet is converted into a magnet, and becoming, consequently, possessed of a north and south pole, it disposes itself after the manner of a regular magnet, and at-

tracts with its extremities the contrary poles of other particles: hence the formation of regular lines by the iron filings, intimating the direction of the magnetic current.

7. A very pretty experiment, similar to the preceding, consists in placing a bar magnet on a table, laying a sheet of white paper over it, and sifting iron filings upon it through a gauze sieve: the filings becoming magnetic, range themselves in very beautiful curves above the poles of the magnet. This experiment performed before any persons unacquainted with magnetism, will have an astonishing effect; for, as they will see no reason why the filings should so arrange themselves they will be much surprised. This is one of that kind of experiments with which the adepts of by-gone days puzzled our fore-fathers, and which gained for many of them the romantic title of magician.

8. By adopting the following simple plan, a bar magnet may be made to bear a very great weight. Tie a piece of strong thread round the middle of it, and tie the other end of the thread to a cross string or beam. Leave the magnet to steady itself; it will traverse, that is, move round (from the position in which you left it) till it points directly north and south. You may now apply gently and gradually, to each end or pole a number of small iron keys, nails, or bars; and the weight it will sustain will surprise you. And it is very remarkable, that the more weight you can make a magnet sustain, the stronger it gets. If you allow the magnet to remain for some days (in a dry place) in the position above described, you will find that every day it will bear an additional

weight; and this power will gradually increase, till it has reached a certain limit. On the other hand, by disusing a magnet, by placing it in an improper situation, or by other things which will be mentioned when we come to treat of the making of magnets, the power of them is diminished. By making a magnet red hot, its power is entirely destroyed. It is shown by this experiment, that the two magnetic poles together are capable of lifting a much greater weight than either of them by itself. On this account natural magnets, in order to fit them for performing experiments of this nature, undergo a process termed arming. In this, the two poles of such magnet are connected by three pieces of iron, one at each end, and the other along the bottom; the latter piece, serving only to concentrate the power by connecting the poles, is not attached to the magnet, but the two end pieces are fastened to the magnet by a brass rim or box, and to the top of the magnet is affixed a ring to hang it up by. To the bottom of the third piece of iron a ring is affixed to hold the weights which the magnet is to raise. For the same purpose, and to avoid the armature, artificial magnets intended to raise weights are commonly made in the shape of a horse-shoe, having their poles in the two extremities. This kind of magnet is always more powerful than the bar kind.

9. The following simple experiment exhibits the attractive and repulsive powers of the magnet in a very curious manner. Dip the north pole of one magnet, and the south pole of another, into steel filings; each will assume when taken out, the appearance of a brush. Bring the two ends thus

coated with filings near each other; the filings will unite. Next, dip the north poles of both magnets into the filings, and bring these two together; in this case, the filings on the opposite magnets will repel each other.

HOW TO MAKE MAGNETS.

Artificial Magnets are made of various shapes, according to the purposes they are intended to answer. For experimental purposes there may be obtained a few bars, five inches in length, half an inch in breadth, and the fourth of an inch in thickness. Magnets in the shape of a horse-shoe are sometimes used; they are better for raising weights than the bar magnets. A smith should be employed to furnish the bars, &c., which must be of hard steel, well polished; their angles must be perfect, and their several sides and ends completely flat. There should be a line drawn across one side of each bar, near one end of it. This marked end of the bar is to be made the north pole of the magnet when the bar is touched; and the mark serves to distinguish the poles of the magnet, which sometimes is very convenient. When bar magnets are laid by for a time, they should be placed in a box with the opposite poles in contact, and must be kept in a dry place. If similar poles were placed together, or if the magnets got rusty, they would be spoiled. A single magnet should have a bit of iron placed at each end of it; and the ends of a horse-shoe magnet should be connected by a piece of iron.

Every piece of iron when brought near a magnet,

become a magnet itself. Soft iron is attracted by the magnet much more powerfully than hard iron or steel: but soft iron retains the magnetic virtue only as long as it continues near the magnet; while hard steel, when once converted into a magnet continues to be one, though removed to a distance from the magnet to which it was originally indebted for the communication of the magnetic quality. This shows the necessity of making the magnets of steel. A bar of steel may be converted into a magnet by simply stroking it with another magnet while it lies in an horizontal position. Thus, lay a bar of steel upon a table, take a magnet, apply the north pole of it to that end of the steel which is required to be made the south pole, (to the end which is not marked,) draw the magnet gently but firmly along the bar to the end of it, then carry away the hand to the distance of a foot; repeat the stroke several times, and your bar will then become a magnet.

The following is another method of communicating magnetism to a steel bar, or compass needle; let it be placed horizontally, take a magnet in each hand, let the north pole of one, and the south pole of the other, be brought obliquely in contact, over the centre of the bar; draw them asunder taking care to press firmly, and to preserve the same angle of inclination to the very ends of the bar, which should be supported by two magnets, whose ends ought to correspond in polarity with the intended poles of the bar. Observe to carry the magnets you press with, clear away from the ends of the bar, at least a foot therefrom; repeat the friction in the same manner several times, perhaps six, eight,

or ten times, and the bar will be permanently magnetized. By using other and stronger magnets in succession, the powers of the bar will be proportionably increased: but, as we have already stated, no effect will result from the friction if the bars are rusty, or, indeed, not highly polished.

This mode of making magnets is more troublesome than that of simply touching or stroking the bars, but then the magnets when made are infinitely better than the others.

The earth is a great magnet. Hence iron, when placed in a proper position, becomes magnetical. We mean to say, that the magnetic virtue can be communicated to iron, without our touching it with any magnet, either natural or artificial. Paradoxical as this may appear, it is nevertheless true. The thing, indeed, may be done in many ways: magnets may be made merely by rubbing together pieces of unmagnetized iron, nay, even without any friction at all. The following information on this very curious subject, we trust will be interesting to our readers.

Take a poker, and having placed it between your knees, in a vertical direction, with the point downwards, affix lengthwise to its upper part, by means of a silk thread, a small plate of soft tempered steel; then holding this apparatus in the left hand by the silk thread, take a pair of tongs, and holding them almost vertically, rub the small bar from the bottom upwards, about a dozen times with the lower end of them; by these means you will communicate to it a magnetic force, capable of making it support a small key.

Place a small bar of steel in a straight line be-

tween two iron bars, in the direction of the magnetic meridian, and in such a manner, that they shall be somewhat inclined towards the north: then take a third bar, and holding it almost vertically, but with the upper extremity a little inclined towards the south, glide the lower extremity of this bar along the three other bars situated in a straight line, taking care to make it move from north to south; the result will be the communication of the magnetic virtue to the bar of steel.

A bar of soft iron three or four feet long, kept some time in a vertical position, will become magnetic, the lower extremity of it attracting south poles, and the upper extremity, north. But if the bar be inverted, the polarity will be reverse. Bars of windows, and other iron bars which have been long in a perpendicular position, have frequently been found to be magnetical. Iron acquires a very perceptible degree of magnetism by hammering, or by undergoing any other process by which it is violently acted upon (without being changed in its nature). Electric shocks, and lightning, frequently render iron magnetical.

SIMPLICITY OF MAGNETIC APPARATUS.

The apparatus necessary for prosecuting the study of magnetism is very small, and procurable at but little expense; no objections can therefore be made to the pursuit of this science, on the score of economy. For those who do not intend to be very accurate, a common artificial bar magnet, a horse-shoe magnet, and a few sewing needles, knitting needles, and pieces of soft iron wire, will

be sufficient to furnish much amusement. But where greater accuracy is required, it will be necessary to have a set of bars, about six; a few small magnetic needles; a large needle in a box, with a graduated circle, or compass card; a dipping needle; and some pieces of steel wire; bars of soft iron, and a few other trifles which will be suggested to the student, by the perusal of the experiments we give.

THE TRICKS OF COMUS THE CONJUROR.

For some years past, the properties of the magnet have been employed in the performance of several tricks, which cannot but excite a considerable degree of astonishment in those who for the first time behold them. One Comus, a professor of legerdemain at Paris, was the first who called the loadstone to his aid when exhibiting his feats. He could not have gained a more powerful or more secret auxiliary; for the action of the magnet is as certain as (by the vulgar) it is unsuspected. When Comus commenced the performance of his magnetic tricks, all Paris flocked with eagerness to see them. The ignorant admired him, and reckoned him a conjuror; the learned attempted to find out the artifice; but as long as the secret of the influence of magnetism was preserved, so long was the discovery delayed. These deceptions have since been exhibited in this country, by several travelling "professors of recreative philosophy." We should be glad to present to our readers directions for performing these tricks; but some of them would require more time and more money to be spent in

the practising of them, than many of our readers would care to spend. We shall therefore content ourselves with noticing the thing; and we refer the curious to the article Magnetism, in any of the large Encyclopedias, where they will find every particular relating to the subject, fully discussed. In order, however, to give such as have no opportunity of referring to these works, some idea of what these tricks are, we shall describe some of the simplest and most entertaining.

Probably the best of all the magnetic tricks was the exhibition of

THE LITTLE LEARNED SWAN.

It was advertised that a little swan should be produced, which, though made of wax, should tell the hour at the word of command, and spell any word which the company proposed. A large audience assembled, and the exhibition commenced.

Upon the table was placed a broad shallow vessel, round the margin of which was inscribed the letters of the alphabet, and the hours of the day. Having nearly filled this vessel with water, the exhibiter produced his swan, which was formed of wax, and about two inches in length, this was handed round to the company for examination, and then placed in the water, in the centre of which it remained without motion. The exhibiter then took in his hand a piece of bread and held it to the edge of the table; upon which the swan swam directly towards the bread, and put its bill against it, as if to eat it. After a short time the exhibiter took the bread away, and presented a small staff to the

swan, upon which it returned to the centre of the vessel; the exhibiter afterwards showed, that, by means of this staff he could make the swan approach any letter or figure marked on the basin, though he never touched the swan, or any part of the table with it; and even though he himself stood at a pretty considerable distance; he could also make the swan go completely round the basin, by merely walking round the table himself; while, at other times, by presenting his "magic" staff towards the swan, he caused it to turn away, and to swim from it to the other side of the basin.

Wonderful as these things were, and astonished as were the spectators, the exhibiter shewed afterwards that he could carry the wonder and astonishment still further; for, advancing into the centre of the room, he declared with an emphatic tone, that his swan could not only obey his motions, but his call; to convince them of which, after requesting the company to name a word, which his swan should spell, he retreated to the farthest side of the room, and calling there the letters, one by one, the swan, to the infinite surprise and pleasure of every one, swam about the basin, and regularly pointed with its bill to every letter as it was named. This feat elicited repeated shouts of applause, and closed the exhibition—an exhibition from which every spectator went away astonished and delighted.

A very short explanation of this feat, will satisfy those who have read what we have said about magnetic attraction and repulsion. They will immediately conceive that the body of the swan contained a small but powerful magnet, and that the exhibiter's staff contained another magnet; the one end of

the pole of which attracted the swan, and the other repelled it.

In the latter part of the exhibition, when the juggler stood at the other side of the room, the swan was moved, not by him, but by a child concealed beneath the table, who, upon hearing the letter named, directed the swan to it by means of a powerful loadstone held against the corresponding letter in an index beneath the table.

If any one wishes to possess a swan of this kind, he may, by applying to some of the philosophical instrument makers, be furnished with a very elegant one, made of copper, and painted, for the sum of three shillings. He also may be furnished with a variety of other magnetic toys, such as ships, mermaids, syrens, and dolphins, at very low prices. A neat little thing of this kind, is a fish, which is put into water, and which, when a magnetized iron hook, fastened by a thread to a small rod is also lowered into the water, swims to the hook, and is drawn up by it. The cost of this apparatus is not above fifteen pence. We mention these things, in order that young students, who might like to astonish their "country cousins" may know how to go to work to get these curiosities.

Artificial magnets may be purchased at the same places as those toys, of various shapes and sizes, and at very moderate prices.

THE MAGNET SPY-GLASS.

Our friend Comus had a spy-glass, which, according to his account, enabled him to see through a deal board, or any thing else equally transparent.

Other people who looked through the glass, (or rather through another one which externally resembled it, and which he dexterously substituted in its place,) were not a whit more sharp-sighted than if they had looked through a common glass.

The one which Comus saw through was made as you may make one, if you observe the following directions:—

Provide a tube of ivory, very thin at the sides, two inches and a half long, and something wider at bottom than at top. It must open at one end with a screw: at the end there must be placed an eye-glass of about two inches focus, and at the other end a plain glass. Upon this bottom glass is to be placed a piece of ivory, having in the centre a pivot, bearing a well-touched, very sensible magnetic needle; which needle, when the spy-glass rests upon its broad end, lies horizontally, and points north and south, or towards any magnet placed near it. If the sides of the ivory tube are very thin, which they must be, to let in the light, by looking through the eye-glass the position of the needle at any time may be seen. We have now to show to what use Comus applied the magic spy-glass.

THE COMMUNICATIVE CROWN.

Take a crown piece, and bore a hole in the side of it, in which place a piece of wire, or a large needle, well polished and strongly magnetized. Then close the hole with a small piece of pewter, that it may not be perceived. Now the needle in the magic spy-glass when it is brought near to this

piece of money will fix itself in a direction corresponding to the wire or needle in that piece;—but of this more anon. Desire any person to lend you a crown piece, which you dexterously change for the one you have prepared as above. Then give the latter piece to another person, and leave him at liberty to put it in a snuff-box or not, privately; he is then to place the snuff-box on the table, and you are to tell him if the crown piece is, or is not, in the box. This you are to pretend to discover by means of your magic spy-glass, a thing which is to enable you to see through the cover of the box. The fact is, that you are to bring the bottom of your spy-glass close to the box, when, if the crown be in it, the magnet it contains will cause the needle in the spy-glass to turn round.

THE MYSTERIOUS WATCH.

Under the top of a common table, place a magnet that turns on a pivot; and fix a board under it, that nothing may appear. There also may be a drawer under the table, which you pull out to show that there is nothing concealed. At one end of the table there must be a pin, that communicates with the magnet, and by which it may be placed in different positions: this pin must be so placed as not to be visible to the spectators. Desire any person to lend you his watch, and ask if it will go if laid on the table. If he says it will: you place it over the end of the magnet, and it will presently stop. You then mark with a chalk or pencil, the precise point where you placed the watch, and give the watch to another person, de-

siring him to repeat the experiment; at the same time, placing your hand in a careless manner on the pin at the end of the table, you alter the position of the magnet; the person will not then be able to succeed in the experiment. You then give the watch to a third person, and replacing the magnet, you enable him to succeed in stopping the watch by placing it on the table.

In this experiment, the balance of the watch must be of steel, and the magnet must be a strong one.

THE LEARNED FLY, OR THE SYREN.

This trick is somewhat more complex than the preceding, and depends partly on philosophical principles, and partly on a little deception. You must provide a table, with a box sunk in its thickness, and the box must be furnished with a broad brim, inscribed with numbers, the hours of the day, or answers to certain questions. You then desire a person to point out a number, or to name any hour in the day, or to ask what o'clock it is, or to select any one of certain questions written upon cards which you present to him. A fly, a syren, or swan, floating in water, indicates, in their order, the figures of this number, or answers the question proposed.

All this is performed by means of a strongly magnetized bar, supported by a brass circle, concealed in the rim of the basin which contains the water. It is evident that if the motion, necessary to point out the letters or numbers required for the answer, can be given to this bar, the fly or syren,

placed on a small boat containing another magnetic bar, will proceed towards it, and appear to answer the question. Such are the philosophical principles of this trick; the deception is as follows;

The table, which is some inches in thickness, is hollow, and the cavity contains a certain mechanism put in motion by a string, which, passing through the feet of the table, traverses the floor, and is conveyed into a neighbouring apartment, separated from that where the trick is exhibited only by a very slight partition. This string terminates at a sort of table, on which are marked the divisions of the basin: and the whole is combined in such a manner, that when the end of the string is brought opposite to a certain figure, such as 4, for example, the magnetic bar will be under the 4 inscribed on the edge of the vessel.

When the syren then is desired to tell what o'clock it is; the person behind the partition, who hears the question, has nothing to do but to pull the string, and to bring the end of it opposite to the required hour on the table which is before him. The magnetic bar will arrange itself below, and the tractable syren, beginning to move, will go and point out the hour.

If a question has been selected, the person who exhibits the trick repeats it under a pretence of interrogating the syren. The confederate, who hears it, causes the magnetic bar to move to the answer.

It would not be a very difficult matter to establish between both a secret communication of such a nature, that, even without speaking, the syren

should appear to guess the question, and to give an answer to it.

WHAT MAGNETISM TEACHETH US.

There is a reflection of a very interesting kind, which arises from our subject very naturally, and that is this:—that a thing, which, for hundreds of years, was esteemed merely as a source of amusement, as a toy for the idly curious, should by a casual discovery, be proved to be capable of rendering to mankind the most important benefits; that a thing which pleased ten men under the guise of a simple sport, should contain a present of inestimable value; that the philosopher's stone should turn out to be the toy of a child! What important lessons do we not learn from the discovery of the properties of the magnet!

We learn, that an object connected with science, though it seem at first to lead only to idle speculation, ought not on that account to be ridiculed or consigned to oblivion. We learn, that the investigation, of every effect, of which the cause is unknown, however trifling such effect may appear to be, is a thing well worthy of the attention of every one, however high his station, or however acute his philosophic penetration; since that thing is not below the greatest man on earth, which contains a secret, of which the discovery would prove of universal benefit.

The study of the hidden principles of nature, is calculated to sharpen the sagacity of the mind, and to improve the reasoning faculties; it therefore is an employment for youth, which all should

be proud to engage in, and none could pursue unimproved.

ON GALVANISM.

A galvanic apparatus, consisting of twenty troughs, 12 inches by $2\frac{1}{4}$, being provided, each trough was furnished with two plates of copper, so disposed as to support the rod of copper, which sustains the zinc plate in the fluid of the next trough. The conducting liquid consisted of pure water, containing a sixtieth of its weight in sulphuric acid, and the same of nitric acid. In all subsequent experiments, a single pair of large plates was found more efficacious than a number of small plates; but it was also found, when the wires from all the zinc plates were connected on one side, and those from all the copper plates on the other, the electro-magnetic influence always increased with the number of the plates. A zinc plate of ten inches was immersed in the liquid, and a wire united the extremities of the pile; the effect produced hereby was termed the electric conflict, and the wire from its application, receives the name of 'conjunctive wire.' This we adopt as simple, and clearly indicative of its use; and the effect produced being by the contrary motion of two electric currents, by means of the conjunctive wire, and therefore we shall so term them 'conflicting electrical currents.' How this conflicting current acted upon the needle will be subsequently shewn; meantime, some interesting facts, which have been elicited by the indefatigable discoverer, assisted by the labours of Ampere, Davy, Hansteen, and others,

may be here profitably set down, although resulting from the experiments which close this series.

DECLINATION OF THE NEEDLE AFFECTED BY GALVANIC ELECTRICITY.

Above a magnetic needle, well suspended, and in equilibrio in the magnetic meridian, is placed a straight part of the conjunctive wire, so as to be horizontal and parallel with the needle; which may be accomplished by bending it near its efficacious part. When this is done, the needle will be found to deviate from its position, and the pole which is nearest the negative end of the battery will move to the westward; and the whole declination thereof will be forty-five degrees, decreasing to thirty degrees with the smallest kind of wire. But a connecting wire which shall be one-fifteenth of an inch diameter, being placed horizontally, in the plane of the magnetic meridian, over the compass, the deviation of the needle will be eighty degrees and upwards.

But if, instead of placing the wire above the needle, it is now placed below it, the effect produced will be the direct contrary; the pole nearest the negative end of the battery then moving to the eastward, at the same degree as by the former experiments its deviations were westerly. Again, if the conjunctive wire is caused to turn in an horizontal plane, so as to deviate gradually from the magnetic meridian on either side, the declination of the needle will increase if the wire approaches the needle, and will diminish if it recedes from it.

NEW ELECTRICAL PHENOMENA.

The effect of stroking a cat's back briskly with the hand, is well known as a domestic recreation; has been long and generally practised as an amusement, and is frequently adopted as a pastime of winter evenings. Shocks may also be imparted to the other hand than that which is employed in stroking the animal, by forming the electric circle as follows: Let the cat be placed before a good fire, some ten or fifteen minutes; then take it up on the lap of the operator, who passing the hand over its back the usual scintillæ will be emitted; but let the other hand be applied to the throat, so as the finger and thumb touch the jaw or shoulder bone, and the hand so applied will feel slight shocks, as if discharged by the Leyden phial.

ELECTRICAL PHENOMENA.—THE KITE.

Make a small cross of two strips of cedar, the arms long enough to reach to the four corners of a large silk handkerchief, when extended; tie the corners of the handkerchief to the extremities of the cross, and you have the body of the kite; which being properly furnished with a tail, loop, and string, will rise in the air like those made of paper; but this being of silk, is better adapted to bear the wet and wind of a thunder gust, without tearing. On the top of the upright stick of the cross is to be fixed a sharp upright wire, rising a foot or more above the wood. To the end of the twine, next the hand is to be tied a silk ribbon, and where the silk and

twine join, a key may be fastened. The kite is to be raised when a thunder storm appears to be coming on; and the person who holds the string must stand within a door or window, or some such cover, so that the silk ribbon may not be wetted with the rain; and care must be taken the twine does not touch the frame of the door or window.

As soon as any thunder clouds come over the kite, the pointed wire will draw from them the electric fire, and the kite, with all the twine, will be electrified, while the loose filaments of the twine will stand out every way, and be attracted by an approaching finger. When the rain has wetted the kite and twine, so that it can conduct the electric fire freely, the operator will find it stream out plentifully from the key on the approach of his knuckle. At this key an electric phial may be charged; and from electric fire, thus obtained, spirits may be kindled, and all other electric experiments performed, which are usually done by the help of a rubbed glass or tube, and thereby the identity of the electric matter with that of lightning completely demonstrated.

N. B.—Much care is necessary, when much lightning takes place; the string must then be held by a peg.

AIR PUMP.—RESISTANCE OF ARCHED BODIES.

Let two phials, the one a square the other a round one, be furnished with a valve stopper, and placed in the receiver. Exhaust the air therefrom, and the valves opening will have their respective

phials in vacuum also; then turn the cock that readmits the air, the valves being closed, the pressure of the air will press upon and burst the square phial, whilst the round one withstands the pressure entire, by reason of its shape; and this, although, as is usually the case, the round phial be a blown one, and very thin, whilst square phials are always cast, and of thick materials.

The receiver itself is a proof of the same doctrine; but for its arched top the surrounding atmosphere would shiver it to atoms whenever its side should be exhausted. The same effect would be produced by corking down the phials, so that the air cannot escape; the pressure from without being withdrawn, that within forces the barrier and the stopper flies out, or the square phial bursts.

HYDROGEN GAS, TO MANUFACTURE.

Let a phial be provided, which has a cork-stopper with a hole in its centre, capable of admitting tightly the end of a tobacco pipe. Into the phial drop a few bits of zinc, steel filings, or scraps of iron. To this pour reduced oil vitriol, prepared in another vessel by a simple admixture of water; and when the heat hereby occasioned, has subsided, introduce it to the metals in your phial, and cork it down with the stopper heretofore described. Immediately, the hydrogen contained in the liquid will begin to fly off, by reason of the attraction which resides in the metal, for the other component part of the liquid. The gas thus liberated, ascends in a stream, and may be lighted with a candle, or com-

ducted into the bladder fitted up with a tobacco pipe, as described in the last recreation.

For this purpose, the end of the tobacco pipe, which projects from the neck of the bladder, is to be quickly thrust into the hole of the cork of your phial, and the bladder will be filled with the gas which arises from the decomposition that is going on in the phial.

BARS OR NEEDLES RENDERED MAGNETIC BY THE GALVANIC ARC.

A new method of communicating the polar attraction to the needle, is adverted to in the experiments of Mr. Oersted. Sir H. Davy found that the conjunctive wire of platina was magnetic, from its attracting iron filings; and it was found capable of communicating permanent magnetism to steel bars, placed transversely; whilst the same bars, when placed to the wire, had temporary magnetism while in the vicinity of the apparatus. When the south pole of a magnetic bar received negative electricity, the power of attraction was destroyed in half a minute.

ACETATE OF LEAD WITH HYDROGEN.

Super acetate of lead and sulphurated hydrogen in contact, produce a colour, more or less, according to the amount used of the former; if in water which has been impregnated with sulphurated hydrogen gas, a drop or two of the super acetate be added,

clouds will ensue of a dark brown colour, floating in varied evolutions.

Secondly, dip your pen in a diluted solution of super acetate of lead, and write, nothing will be visible; but pass over the paper a sponge charged with water, impregnated as above, and the writing assumes a brilliant metallic appearance. The same effect may be produced by simply holding the writing over the vessel which contains the preparation of hydrogen gas.

CHLORINE.

Fill a small jar with chlorine, or oxymuriatic acid gas, and transfer it into a basin, containing a solution of nitrate, or muriate of ammonia, a little warmed. The gas will shortly become condensed, the liquor rise up in the jar, and presently an oily liquid forms on its surface.

This increases and collects into small globules, and falls through the liquid, and forms the explosive compound of which we are in search; but when found, much danger exists in the means of gathering it together, many accidents have occurred of a frightful nature, substances most similar in their nature being affected very differently towards the oil; charcoal of wood seems uniformly innocent in tact with it, and therefore offers one of the safest vehicles for removing it. Mr. Kirk found it would not explode upon alcohol or ether, whilst fire heat at 212° of Fahrenheit produced detonation, though not so loud, as when cold it were touched with inflammable bodies. In olive oil, for example, a quantity of the size of a pin's head will explode violently and

loud, knocking the vessel, in which it takes place to atoms.

Seeing that so much danger and doubt is found with this curious substance, the precaution of wearing a visor with eye glasses in it, and perhaps a pair of gloves, must be evidently necessary.

DETONATING POWDER.

To three grains of finely levigated chlorine, or hyperoxymurate of potash, add two grains of sulphur, mix them well, in a clean dry mortar. Collect them together at its bottom, and with the pestle press the powder hard, by bringing it down at the sides of the mortar, suddenly, whereby friction against its bottom takes place. A loud detonation ensues with a vivid flash. But if the pestle be turned briskly round, as is usual with druggists, after some time pounding any substance, repeated small reports will take place, attended with vivid flashes, not unlike what we see and hear in the electric shock. It is here worthy of remark, that if less sulphur be used, less friction is necessary to produce the several reports. Like most others of its class, it may be conveyed about, when care is used, and be suddenly ignited; in this case, by being struck with a hammer its noise is equal to that of a horse pistol.

CO-EXPLOSION OF FULMINATING SILVER.

If small parcels of this preparation be laid out upon the table, or a train of considerable length, and one parcel be touched with sulphuric acid, the whole

detonates spontaneously; which must arise from the compression of the atmosphere.

PROCESS OF SEPARATING SILVER AND COPPER.

Its cheapness is the principal recommendation of this method, which is also most effectual and complete in operation. Dissolve the substance in nitric acid, and evaporate the solution to dryness in a glass vessel. Place the salt in an iron spoon over a moderate fire, and keep the mixture in fusion until it entirely ceases to throw up bubbles, when it is to be poured off upon an oiled plate. To be certain that all the nitrate of copper is converted into the black oxide of copper, dissolve a small portion thereof in water, and test it with ammonia. If the solution, which ought to be at first clear and limpid, does not acquire the slightest tint of blue, it may be considered, that the nitrate of silver obtained is quite free from copper. If not so the fusion must be continued a few seconds longer.

The black product is to be dissolved in cold water, and the solution being filtered, the nitrate of silver passes through in a state of purity. By washing the oxide which remains upon the filter, the small portion of nitrate of silver with which it may be impregnated will be removed: the oxide is then to be dried. The nitrate of silver is to be subjected to a different treatment, according to the use to which it is to be applied.

IGNIS FATUUS, OR WILL-O-THE WISP.

To a small quantity of water, in a glass tumbler, add phosphoret of lime in two or three small lumps, shortly will arise little flashes of light, darting out like petty lightning, and ascending subsequently in curling clouds ; these appearances continue some time, and constitute a lively illustration of the formation of ignis fatuus, or light proceeding out of shallow pools of water.

LUMINOUS BOTTLE, OR WATCH-LIGHT.

A bit of phosphorus, the size of a pea, is to be put into a long glass phial, and boiling oil poured carefully over it, till the phial is one-third filled. The phial must be carefully corked, and when used, should be unstopped a moment to admit the external air, and closed again. The empty space of the phial will then appear luminous, and give as much light as a dull ordinary lamp, and just sufficient to see the face of a watch. Each time that the light disappears, on removing the stopper it will instantly re-appear. In cold weather the bottle should be warmed in the hands before the stopper is removed. A phial thus prepared may be used every night for six months.

MAGIC FOUNTAIN.

Take a tall glass tube, hermetically sealed both at top and bottom, by means of a brass cap screwed on to a stop-cock, and that to the plate of the pump.

When the air is exhausted, turn the cock, take the tube of the plate, and plunge them into a basin of mercury or water. Then the cock being again turned, the fluid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

CORK HEAVIER THAN LEAD.

Let a large piece of cork be pendent from one end of a balance beam, and a small piece of lead from the other; the lead should rather preponderate. If this apparatus be placed under a receiver on the pump, you will find that when the air is exhausted, the lead which seemed the heaviest body will ascend, and the cork will outweigh the lead. Restore the air, and the effect will cease. This phenomenon is only on account of the difference of the size in the two objects. The lead, which owes its heaviness to the operation of the air, yields to a lighter because a larger substance, when deprived of its resistance.

THE ILLUMINATED WATER.

Connect one end of a chain with the outside of a charged phial, and let the other end lie on the table. Place the end of another piece of chain at the distance of about a quarter of an inch from the former, and set a glass decanter of water on these separated ends. On making the discharge, the water will appear perfectly luminous.

The electric spark may be rendered visible in water, in the following manner. Take a glass tube

of about half an inch in diameter, and six inches long; fill it with water, and to each extremity of the tube, adapt a cork, which may confine the water, through each cork insert a blunt wire, so that the extremities of the wires within the tube may be very near one another; then, on connecting one of these wires with the coating of a small charged phial, and touching the other wire with the knob of it; the shock will pass through the wires, and cause a vivid spark to appear between their extremities within the tube. The charge in this experiment must be very weak, or there will be danger of bursting the tube.

TO SPIN SEALING-WAX INTO THREADS BY ELECTRICITY.

Stick a small piece of sealing-wax on the end of a wire, and set fire to it. Then put an electrical machine in motion, and present the wax just blown out at the distance of some inches from the prime conductor. A number of extremely fine filaments will immediately dart from the sealing-wax to the conductor, on which they will be condensed into a kind of net-work, resembling wool.

If the wire with the sealing-wax be struck into one of the holes of the conductor, and a piece of paper be presented at a moderate distance from the wax, just after it has been ignited, on setting the machine in motion, a net-work of wax will be formed on the paper. The same effect, bnt in a slighter degree, will be produced, if the paper be briskly rubbed with a piece of elastic gum, and the melting

sealing-wax be held pretty near the paper immediately after rubbing.

If the paper thus painted, as it were, with sealing-wax, be gently warmed by holding the back of it to the fire, the wax will adhere to it, and the result of the experiment will thus be rendered permanent.

SEVERAL DIFFERENT CARDS BEING FIXED ON BY DIFFERENT PERSONS, TO NAME THAT ON WHICH EACH PERSON FIXED.

There must be as many different cards shewn to each person, as there are cards to choose; so that, if there are three persons, you must shew three cards to each person, telling the first to retain one in his memory. You then lay those three cards down, and shew three others to the second person, and three others to the third. Next take up the first person's cards, and lay them down separately, one by one, with their faces upwards; place the second person's cards over the first, and the third over the second's, so that there will be one card in each parcel belonging to each person. You then ask each of them in which parcel his card is, and by the answer, you immediately know which card it is; for the first person's will always be the first, the second person's the second, and the third person's the third in that parcel where each lays his cards.

This amusement may be performed with a single person, by letting him fix on three, four, or more cards. In this case you must shew him as many parcels as he is to choose cards, and every parcel

must consist of that number, out of which he is to fix on one, and you then proceed as before, he telling you the parcel that contains each of his cards.

TO TELL THE AMOUNT OF THE NUMBERS OF ANY TWO CARDS DRAWN FROM A COMMON PACK.

Each court card in this amusement counts for ten, and the other cards according to the number of their pips. Let the person who draws the cards add as many more cards to each of those he has drawn as will make each of their numbers twenty-five. Then take the remaining cards in your hand, and, seeming to search for some card among them, tell them over to yourself, and their number will be the amount of the two cards drawn.

For example:—Suppose the person has drawn a ten and a seven, then he must add fifteen cards to the first, to make the number twenty-five, and eighteen to the last for the same reason; now fifteen and eighteen make thirty-three, and the two cards themselves make thirty-five, which deducted from fifty-two, leaves seventeen, which must be the number of the remaining cards, and also of the two cards drawn.

You may perform this amusement without touching the card, thus:

Let the person who has drawn the two cards deduct the number of each of them from twenty-six, which is half the number of the pack, and after adding the remainders together, let him tell you the amount, which you privately deduct from fifty-two,

the total number of all the cards, and the remainder will be the amount of the two cards.

EXAMPLE:—Suppose the two cards to be as before, ten and seven; then the person deducting ten from twenty-six, there remain sixteen; these two remainders make thirty-five, which you subtract from fifty-two, and there must remain seventeen for the amount of the two cards, as before.

THE CARD CHANGED BY WORD OF COMMAND.

You must have two cards of the same sort in the pack, say the king of spades. Place one next the bottom card, (say seven of hearts) and the other at top. Shuffle the cards without displacing those three, and show a person that the bottom card is the seven of hearts. This card you dexterously slip aside with your finger, which you have previously wetted, and taking the king of spades from the bottom, which the person supposes to be the seven of hearts, lay it on the table, and telling him to cover it with his hand.

Shuffle the cards again, without displacing the first and last card, and shifting the other king of spades from the top to the bottom, shew it to another person. You then draw that privately away, and taking the bottom card, which will then be the seven of hearts, you lay that on the table, and tell the second person (who believes it to be the king of spades) to cover it with his hand.

You then command the cards to change places: and when the two parties take off their hands, and

turn up the cards, they will see to their great astonishment, that your commands are obeyed.

THE CARD IN THE EGG.

Take a card, the same as your long card, and rolling it up very close, put it into an egg, by making a hole as small as possible, and which you are to fill up carefully with white wax. You then offer the long card to be drawn; and when it is replaced in the pack, you shuffle the cards several times, giving the egg to the person who drew the card, and while he is breaking it, you privately withdraw the long card, that it may appear upon examining the cards, to have gone from the pack into the egg. This may be rendered more surprising by having several eggs, in each of which is placed a card of the same sort, and then giving the person the liberty to choose which egg he thinks fit.

This deception may be still further diversified, by having, as most public performers have, a confederate, who is previously to know the egg in which the card is placed; for you may the break the other eggs, and shew that the only one that contains a card is that in which you directed it to be.

THE HOUR OF THE DAY OR NIGHT TOLD BY A SUSPENDED SHILLING.

However improbable the following experiment may appear, it has been fully proved by repeated trials:

Sling a shilling or sixpence at the end of a piece

of thread by means of a loop. Then resting your elbow on a table, hold the other end of the thread betwixt the fore-finger and thumb, observing to let it pass across the ball of the thumb, and thus suspend the shilling into an empty goblet. Observe your hand must be perfectly steady; and if you find it difficult to keep it in an immoveable posture, it is useless to attempt the experiment. Premising, however, that the shilling is properly suspended, you will observe, that when it has recovered its equilibrium, it will for a moment be stationary: it will then of its own accord, and without the least agency from the person holding it, assume the action of a pendulum vibrating from side to side of the glass; and after a few seconds, will strike the hour nearest to the time of day: for instance, if the time be twenty-five minutes past six, it will strike six; if thirty-five minutes past six, it will strike seven, and so on of any other hour.

It is necessary to observe, that the thread should lay over the pulse of the thumb, and this may in some measure account for the vibration of the shilling; but to what cause its striking the precise hour is to be traced, remains unexplained; for it is no less astonishing than true, that when it has struck the proper number, the vibration ceases, it acquires a kind of rotary motion, and at last becomes stationary as before.

ARTIFICIAL LIGHTNING.

Provide a tin tube that is larger at one end than it is at the other, and in which there are several holes. Fill this tube with powdered resin; and

when it is shook over the flame of a torch, the reflection will produce the exact appearance of lightning.

ARTIFICIAL THUNDER.

Mix two drachms of the filings of iron, with one ounce of concentrated spirit of vitriol, in a strong bottle that holds about a quarter of a pint; stop it close, and in a few minutes shake the bottle: then taking out the cork, put a lighted candle near its mouth, which should be a little inclined, and you will soon observe an illumination arise from the bottle, attended with a loud explosion.

To guard against the danger of the bottle bursting the best way would be to bury it in the ground, and apply the light to the mouth by means of a taper fastened to the end of a long stick.

ARTIFICIAL ILLUMINATIONS.

A very pleasing exhibition may be made with very little trouble or expence, in the following manner: Provide a box, which you fit up with architectural designs cut out on pasteboard: prick small holes in those parts of the building where you wish the illuminations to appear, observing, that in proportion to the perspective, the holes are to be made smaller; and on the near objects the holes are to be made larger. Behind these designs thus perforated, you fix a lamp or candle, but in such a manner, that the reflection of the light shall only shine through the holes; then placing a light of just sufficient brilliance to shew the design of the building before

it, and making a hole for the sight at the front end of the box, you will have a very tolerable representation of illuminated buildings.

The best way of throwing the light in front is to place an oiled paper before it, which will cast a mellow gleam over the scenery, and not diminish the effect of the illumination. This can be very easily planned, both not to obstruct the sight, nor be seen to disadvantage. The lights behind the picture should be very strong; and if a magnifying glass were placed in the sight-hole, it would greatly tend to increase the effect. The box must be covered in, leaving an aperture for the smoke of the lights to pass through.

The above exhibition can only be shewn at candle-light; but there is another way, by fixing small pieces of gold on the building instead of drilling the holes, which gives something like the appearance of illumination, but by no means equal to the foregoing experiment.

N. B. It would be an improvement, if paper of various colours, rendered transparent by oil, were placed between the lights behind, and the aperture in the buildings, as they would then resemble lamps of different colours.

ARTIFICIAL EARTHQUAKE AND VOLCANO.

Grind an equal quantity of fresh iron filings with pure sulphur, till the whole be reduced to a fine powder. Be careful not to let any wet come near it. Then bury about thirty pounds of it a foot deep in the earth, and in about six or eight hours the ground will heave and swell, and shortly after send

forth smoke and flames like a burning mountain. If the earth is raised in a conical shape, it will be no bad miniature resemblance of one of the burning mountains.

TO PRODUCE BEAUTIFUL FIRE WORKS IN MINIATURE.

Put half a dram of solid phosporus into a large pint Florence flask; holding it slanting, that the phosporus may not break the glass. Pour upon it a gill and a half of water, and place the whole over a tea-kettle lamp, or any common tin lamp, filled with spirits of wine. Light the wick, which should be almost half an inch from the flask; and as soon as the water is heated, streams of fire will issue from the water by starts, resembling sky-rockets; some particles will adhere to the sides of the glass, representing stars; and will frequently display brilliant rays. These appearances will continue at times till the water begins to simmer, when immediately a curious aurora borealis begins, and gradually ascends, till it collects to a pointed flame; when it has continued half a minute, blow out the flame of the lamp and the point that was formed will rush down, forming beautiful illuminated clouds of fire, rolling over each other for some time, which, disappearing, a splendid hemisphere of stars presents itself; after waiting a minute or two, light the lamp again, and nearly the same phenomenon will be displayed as from the beginning. Let the repetition of lightning and blowing out the lamp be made for three or four times at least, that the stars may be increased. After the third or fourth time

of blowing out the lamp, in a few minutes after the internal surface of the flask is dry, many of the stars will shoot with great splendour from side to side, and some of them will fire off with brilliant rays; these appearances will continue several minutes. What remains in the flask will serve for the same experiment several times, and without adding any more water. Care should be taken, after the operation is over, to lay the flask and water in a cool secure place.

ARTIFICIAL RAIN AND HAIL.

Make a hollow cylinder of wood; let it be very thin at the sides, about eight or ten inches wide, and two or three feet in diameter. Divide its inside into five equal parts by boards of five or six inches wide, and let there be between them and the wooden circle, a space of about one-sixth of an inch. You are to place these boards obliquely. In this cylinder put four or five pounds of shot that will easily pass through the opening. When turned upside down, the noise of the shot going through the various partitions will resemble rain; and if you put large shot, it will produce the sound of hail.

CHEMICAL ILLUMINATIONS.

Put into a middling sized bottle, with a short wide neck, three ounces of oil or spirit of vitriol, with twelve ounces of common water, and throw into it, at different times, an ounce or two of iron

filings. A violent commotion will then take place, and white vapours will arise from the mixture. If a taper be held to the mouth of the bottle, these vapours will inflame, and produce a violent explosion; which may be repeated as long as the vapours continue.

THE PHILOSOPHICAL CANDLE.

Provide a bladder, into the orifice of which is inserted a metal tube, some inches in length, that can be adapted to the neck of a bottle, containing the same mixture as in the last experiment. Having suffered the atmospheric air to be expelled from the bottle, by the elastic vapour produced by the solution, apply the orifice of the bladder to the mouth of the bottle, after carefully squeezing the common air out of it, (which you must not fail to do, or the bladder will violently explode.) The bladder will thus become filled with the inflammable air, which when forced out against the flame of a candle, by pressing the sides of the bladder, will form a beautiful green flame.

FULMINATING GOLD.

Put into a small long-necked bottle, resting on a little sand, one part of fine gold filings, and two parts of aqua regia, (nitro-muriatic acid). When the gold is dissolved, pour the solution into a glass, and add five or six times the quantity of water. Then take spirit of sal ammoniac or oil of tartar, and pour it drop by drop into the solution, until the gold is entirely precipitated to the bottom of the glass. De-

cant the liquor that swims at the top, by inclining the glass; and having washed it several times in warm water, dry it at a moderate heat, placing it on paper capable of absorbing all the moisture.

If a grain of this powder, put into a spoon (it should be an iron one,) be exposed to the flame of a candle, it will explode with a very loud report.

A VESSEL THAT WILL LET WATER OUT AT THE BOTTOM, AS SOON AS THE MOUTH IS UNCORKED.

Provide a vessel of tin-plate, two or three inches in diameter, and five or six inches in height, having a mouth about three inches in width; and in the bottom several small holes, just large enough to admit a small needle. Plunge it in water with its mouth open, and when full, while it remains in the water, stop it very closely. You can play a trick with a person, by desiring him to uncork it; if he places it on his knee for that purpose, the moment it is uncorked the water will run through at the bottom, and make him completely wet.

THE MAGIC BOTTLE.

Take a small bottle, the neck of which is not more than the sixth of an inch in diameter. With a funnel, fill the bottle quite full of red wine, and place it in a glass vessel, similar to a shew glass, whose height exceeds that of the bottle about two inches; fill this vessel with water. The wine will shortly come out of the bottle, and rise in the form of a small column to the surface of the water; while, at

the same time, the water entering the bottle, will supply the place of the wine. The reason of this is, that as the water is specifically heavier than the wine, it must hold the lower place, while the other rises to the top.

An effect equally pleasing will be produced, if the bottle be filled with water, and the vessel with wine.

THE GLOBULAR FOUNTAIN.

Make a hollow globe, of copper or lead, and of a size adapted to the quantity of water that comes from a pipe (hereafter mentioned), to which it is to be fixed, and which may be fastened to any kind of pump; provided it be so constructed, that the water shall have no other means of escape than through the pipe. Pierce a number of small holes through the globe, that all tend towards its centre, and annex it to the pipe that communicates with the pump. The water that comes from the pump, rushing with violence into the globe, will be forced out at the holes, and form a pleasing sphere of water.

THE ENCHANTED BOTTLE.

Fill a glass bottle with water to the beginning of the neck; leave the neck empty, and cork it. Suspend this bottle opposite a concave mirror, and beyond its focus, that it may appear reversed. Place yourself still further distant from the bottle; and instead of the water appearing, as it really is, at the

bottom of the bottle, the bottom will be empty, and the water seen at the top.

If the bottle be suspended with the neck downwards, it will be reflected in its natural position, and the water at the bottom, although, in reality, it is inverted, and fills the neck, leaving the bottom vacant. While the bottle is in this position, uncork it, and let the water run gradually out: it will appear, that while the real bottle is emptying, the reflected one is filling. Care must be taken that the bottle is not more than half or three parts full, and that no other liquid is used but water, as in either of these cases, the illusion ceases.

THE SOLAR MAGIC LANTERN.

Make a box, a foot high, eighteen inches wide, and about three inches deep. Two of the opposite sides of this box must be quite open, and in each of the other sides let there be a groove wide enough to admit a stiff paper or pasteboard. You fasten the box against a window, on which the sun's rays fall direct. The rest of the window should be closed up, that no light may enter.

Next provide several sheets of stiff paper, blacked on one side. On these papers cut out such figures as your fancy may dictate; place them alternately in the grooves of the box, with their blacked sides towards you, and look at them through a large and clear glass prism; and if the light be strong, they will appear painted with the most lively colours. If you cut on one of these papers the form of a rainbow, about three quarters of an inch wide, you

will have a very good representation of the natural one.

For greater convenience, the prism may be placed on a stand on the table, made to turn round on an axis.

THE ARTIFICIAL RAINBOW.

Opposite a window into which the sun shines direct, suspend a glass globe, filled with clear water, by means of a string, that runs over a pully, so that the sun's rays may fall on it. Then drawing the globe gradually up, you will observe, when it comes to a certain height, and by placing yourself in a proper situation, a purple colour in the glass; and by drawing it up gradually higher, the other prismatic colours, blue, green, yellow and red, will successively appear; after which the colours will disappear, till the globe is raised to about fifty degrees, when they will again appear, but in an inverted order, the red appearing first, and the blue or violet last; on raising the globe a little higher, they will totally vanish.

THE MAGNETIC WAND.

Bore a hole, three-tenths of an inch in diameter, through a round stick of wood; or get a hollow cane about eight inches long, and half an inch thick. Provide a small steel rod, and let it be thoroughly impregnated with a good magnet; this rod is to be put in the hole you have bored through the wand, and closed at each end by two small ends of ivory that screw on, different in their shapes, that you

may better distinguish the poles of the magnetic bar.

When you present the north pole of this wand to the south pole of a magnetic needle, suspended on a pivot, or to a light body swimming on the surface of the water, (in which you have placed a magnetic bar,) that body will approach the wand, and present that end which contains the south end of the bar; but if you present the north or south end of the wand, to the north or south end of the needle, it will recede from it.

THE MAGNETIC CARDS.

Draw a pasteboard circle; you then provide yourself with two needles, with their opposite points touched with the magnet. When you place that needle, whose pointed end is touched, on the pivot described in the centre of the circle, it will stop on one of the four pips, against which you have placed the pin in the frame; then take the needle off, and placing the other, it will stop on the opposite point.

Having matters thus arranged, desire a person to draw a card from the picked pack, offering that card against which you have placed the pin of the dial, which you may easily do, by having a card a little longer than the rest. If he should not draw it the first time, as he probably may not, you must make some excuse for shuffling them again, such as letting the cards fall, as if by accident, or some other manœuvre, till he fixes on the card. You then tell him to keep it close, and not let it be seen. Then give him one of the two needles, and desire him to place it on the pivot, and turn it round, when it will

stop at the colour of the card he shose; then taking that needle off, and exchanging it unperceived for the other, give it to a second person, telling him to do the same, and it will stop at the name of the identical card the first person chose.

BOTTLES BROKEN BY AIR.

Take a square bottle of thin glass, and of any size. Apply it to the hole in the air pump, and exhaust the air. The bottle will sustain the weight of the external air as long as it is able, but at length it will suddenly burst into very small particles, and with a loud explosion.

An opposite effect will be produced, if the mouth of a bottle be sealed so close that no air can escape; then place it in the receiver, and exhaust the air from its surface. The air which is confined within the bottle, when the external air is drawn off, will act so powerfully as to break the bottle to pieces.

ÆRIAL BUBBLES.

Take a stone, or any other heavy substance, and putting it in a large glass of water, place it in the receiver. The air being exhausted, the spring of that which is in the pores of the solid body, by expanding the particles, will make them rise on its surface in numberless globules which resemble the pearly drops of dew on the tops of the grass. The effect ceases when the air is let into the receiver.

THE MAGIC BELL.

Fix a small bell to the wire that goes through the top of the receiver. If you shake the wire, the bell will ring while the air is in the receiver; but when the air is drawn off, the sound will by degrees become fainter, till at last not the least noise can be heard. As you let the air in again, the sound returns.

THE CUP OF TANTALUS.

You place a cup of any sort of metal on a stool of baked wood or a cake of wax. Fill it to the brim with any liquor; let it communicate with the branch by a small chain; and when it is moderately electrified, desire a person to taste the liquor, without touching the cup with his hands, and he will instantly receive a shock on his lips. the motion of the wheel being stopped, you taste the liquor yourself, and desire the rest of the company to do so: you then give your operator (who is concealed in an adjoining room) the signal, and he again charges the cup; you desire the same person to taste the liquor a second time, and he will receive a second shock.

DANCING BALLS.

Take a common glass tumbler or glass jar, and having placed a brass ball in one of the holes of the prime conductor, set the machine in motion, and let the balls touch the inside of the tumbler; while

the ball touches only one point, no more of the surface of the glass will be electrified, but by moving the tumblers about so as to make the ball touch many points successively, all these points will be electrified, as will appear by turning down the tumbler over a number of pith or cork balls placed on a table. These balls will immediately begin to fly about.

THE ELECTRIC BALLOON.

Two balloons, made of the allantoides of a calf, are to be filled with hydrogen gass, of which each contains about two cubic feet. To each of these is to be suspended, by a silken thread about eight feet long, such a weight as is just sufficient to prevent it from rising higher in the air; they are connected the one with the positive, and the other with the negative conductor, by small wires about 30 feet in length; and being kept nearly 20 feet asunder, are placed as far from the machine as the length of the wires will admit. On being electrified, these balloons will rise up in the air as high as the wire will allow, attracting each other, and uniting as it were into one cloud, gently descending.

FIRE GLOBES FOR THE WATER.

Bowls for water globes ought to be very large, and the wheels on them of ten sides: on each side nail a piece of wood four or five inches long; and on the outside of each piece cut a grove, wide enough to receive about one-fourth of the thickness of a four ounce case; these pieces of wood must be

nailed in the middle of each face of the wheel, and fixed in an oblique direction, so that the fire from the cases may incline upwards; the wheel being thus prepared, tie in each groove a four ounce case, filled with a grey charge; then carry a leader from the tail of one case to the mouth of the other.

Globes for these wheels are made of two tin hoops with their edges outwards, fixed one within the other, at right angles. The diameter of these hoops must be rather less than that of the wheel. Having made the globe, drive in the centre of a wheel an iron spindle, which must stand perpendicular, and its length be four or six inches more than the diameter of the globe.

The spindle serves for an axis, on which is fixed the globe, which must stand four or six inches from the wheel: round one side of each hoop must be soldered little bits of tin, two inches and a half distance from each other; which pieces must be two inches in length each, and only fastened at one end, the other ends being left loose, to turn round the small portfires, and hold them on; these portfires must be made of such a length as will last out the cases on the wheel. There need not be any portfires at the bottom of the globe within four inches of the spindle: as they would have no effect but to turn the wheel: all the portfires must be placed perpendicularly from the centre of the globe, with their mouths outwards: and must be clothed with leaders, so as all to take fire with the second case of the wheel; and the cases must burn two at a time, one opposite the other. When two cases of a wheel begin together, two will end together; therefore the two opposite end cases must have their

ends pinched and secured from fire. The method of firing such wheels is, by carrying a leader from the mouth of one of the first cases to that of the other; and the leader being burnt through the middle, will give fire to both at the same time.

ELECTRIFIED AIR.

Fix two or three pointed needles into the prime conductor of an electrical machine, and set the glass in motion so as to keep the prime conductor electrified for several minutes. If now, an electrometer be brought within the air that is contiguous to the prime conductor, it will exhibit signs of electricity, and this air will continue electrified for some time, even after the machine has been removed into another room. The air, in this case is electrified positively; it may be negatively electrified by fixing the needles in the negative conductor while insulated, and making a communication between the prime conductor and the table, by means of a chain or other conducting substance.

The air of a room may be electrified in another way. Charge a jar, and insulate it; then connect two or three more sharp pointed wires or needles, with a knob of the jar, and connect the outside coating of the jar with the table. If the jar be charged positively, the air of the room will seldom become positively electrified likewise; but if the jar be charged negatively, the electricity communicated by it to the air, will also become negative. A charged jar being held in one hand, and the flame of an insulated candle held in the other, being brought

near the knob of the jar, will also produce the same effect.

ELECTRIFIED BALL.

Provide a ball of cork about three quarters of an inch in diameter, hollowed out in the internal part by cutting it in two hemispheres, scooping out the inside, and then joining them together with paste. Having attached this to a silk thread between three and four feet in length, suspend it in such manner that it may just touch the knob of an electric jar, the outside of which communicates with the ground. On the first contact it will be repelled to a considerable distance, and after making several vibrations with remain stationary; but if a candle be placed at some distance, behind it, so that the ball may be between it and the bottle, the ball will instantly begin to move, and will turn round the knob of the jar, moving in a kind of ellipsis as long as there is any electricity in the bottle. This experiment is very striking, though the motions are far from being regular; but it is remarkable that they always affect the elliptical rather than the circular form.

THE SELF-MOVING WHEEL.

The self-moving wheel is made of a thin round plate of window glass, seventeen inches in diameter, well gilt on both sides, to within two inches of the circumference. Two small hemispheres of wood are then fixed with cement, to the middle of the upper and under sides, centrally opposite, and in each

of them a thick strong wire, eight or ten inches long, making together the axis of the wheel. It turns horizontally on a point at the lower end of its axis, which rests on a bit of brass, cemented within a glass salt cellar. The upper end of its axis passes through a hole in a thin brass plate, cemented to a long and strong piece of glass; which keeps it six or eight inches distance from any non-electric, and has a small box of either wax or metal on its toy.

In a circle on the table which supports the wheel, are fixed twelve small pillars of glass, at about eleven inches distance, with a thimble on the top of each. On the edge of the wheel is a small leaden bullet, communicating by a wire with the upper surface of the wheel; and about six inches from it, is another bullet, communicating, in like manner, with the under surface. When the wheel is to be charged by the upper surface, a communication must be made from the under surface of the water.

When it is well charged it begins to move. The bullet nearest to a pillar moves towards the thimble on that pillar, and passing it, electrifies it, and then pushes itself from it. The succeeding bullet, which communicates with the other surface of the glass, more strongly attracts that thimble, on account of its being electrified before by the other bullet, and thus the wheel increases its motion, till the resistance of the air regulates it. It will go half an hour, and make, one minute with another, twenty turns in a minute, which is six hundred turns in the whole, the bullet or the upper surface giving in each turn twelve sparks to the thimbles, which makes seven thousand two hundred sparks, and the bullet

of the under surface receiving as many from the thimble, these bullets moving in the time nearly two thousand five hundred feet. The thimbles should be well fixed, and in so exact a circle, that the bullets may pass within a very small distance of each of them.

If instead of four bullets you put eight, four communicating with the upper surface, and four with the under surface, placed alternately, (which eight, are about six inches distance, complete the circumference) the force and switness will be greatly increased, the wheel making fifty turns in a minute, but then it will not continue moving so long.

THE ELECTRIC KITE.

Make a small cross of two light strips of cedar, the arms so long as to reach to the four corners of a large thin silk handkerchief when entended; tie the corners of the handkerchief to the extremity of the cross; and you have the body of the kite, which being properly accommodated with a tail, loop, and string, will rise in the air like those made of paper; but this being of silk, is more adapted to bear the wet and wind of a thunder gust, without tearing. To the top of the upright stick of the cross is to be fixed a very sharp pointed wire, rising a foot or more above the wood. To the end of the twine, is to be tied a silk ribbon, and where the silk and twine join, a key may be fastened. This kite is to be raised when a thunder storm appears to be coming on; and the person who holds the string must stand within a door or window, or under some cover so that the silk ribbon may not be wet; and care

must be taken that the twine does not touch the frame of the door or window. As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, while the loose filaments of the twine will stand out every way, and be attracted by an approaching finger. When the rain has wetted the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentifully from the key, on the approach of your knuckle. At this key an electric phial may be charged; and from electric fire thus obtained, spirits may be kindled, and all the other electric experiments performed, which are usually done by the help of a rubbed glass or tube, and thereby the identity of the electric matter with that of lightning completely demonstrated.

THE MAGICAL MIRRORS.

Make two holes in the wainscot of a room, each a foot high, and ten inches wide, and about a foot distant from the other. Let these apertures be about the height of a man's head, and in each of them place a transparent glass in a frame, like a common mirror.

Behind the partition and directly facing each aperture, place two mirrors, inclosed in the wainscot, in an angle of forty five degrees. These mirrors are each to be eighteen inches square; and all the space between them must be enclosed with pasteboard painted black, and well closed, that no light can enter; let their be also two curtains to cover them, which you may draw aside at pleasure.

When a person looks into one of these fictitious mirrors, instead of seeing his own face, he will see the object that is in front of the other; thus, if two persons stand at the same time before these mirrors, instead of seeing himself, they will reciprocelly see each other.

There should be a sconce with a lighted candle, placed on each side of the two glasses in the wainscot, to enlighten the faces of the persons who look in them, or the expriment will not have so remarkable an effect.

A LAMP THAT BURNS WITHOUT A FLAME.

Around the tube of a small alcohol lamp, twist a piece of plantinum wire, one hundredth part of an inch in diameter, and from about ten or a dozen convultions above the tube with the same piece. This may be done by previously twisting the wire around a tobacco pipe. Let the cotton wick be small, having its fibres loose, and standing perpendicular in the tube, but no higher than the third or fourth convolution. The coils towards the top should gradually become smaller as they approach it. The lamp should be a little more than half filled with alcohol, ether, or even camphor. Light the wick, and when the upper coil becomes red hot, blow it out; all the wire above the wick will now arrive at a white heat, and continue to give out a most brilliant light as long as the alcohol, &c. continues to ascend by the capillary attraction of the cotton. In a dark room, a gentle lambent light will be seen playing round the wire.

THE CHINESE SHADOWS. OMBRES CHINOISES.

Make an aperture in a partition wall, of any size, for example, four feet in length, and two in breadth, so that the lower edge may be about five feet from the floor, and cover it with white Italian gauze, varnished with gum copal. Provide several frames of the same size as the aperture, covered with the same kind of gauze, and delineate upon the gauze different figures, such as landscapes and buildings, analogous to the scenes which you intend to exhibit by means of small figures representing men and animals. These figures are formed of pasteboard, and their different parts are made moveable according to the effects intended to be produced by their shadows, when moved backwards and forwards behind the frames, and at a small distance from them. To make them act with more facility, small writes, fixed to their moveable parts, are bent backwards, and made to terminate in rings, through which the fingers of the right hand are put, while the finger is supported by the left, by means of another iron wire: in this manner they may be may to advance or recede, and to gesticulate, without the spectators observing the mechanism by which they are moved: and as the shadow of these figures is not observed in the paintings, till they are opposite those parts which are not strongly shaded, they may thus be concealed, and made to appear at the proper moments, and others may be occasionally substituted in their stead. It

is necessary, when the figures are made to act, to keep a sort of dialogue, suited to their gestures, and even to imitate the noise occasioned by different circumstances. The paintings must be illuminated from behind, by means of a reverberating lamp, placed opposite to the centre of the painting, and distant from it about four or five feet.

Various amusing scenes may be represented in this manner, by employing small figures of men and animals, and making them move in as natural a way as possible, which will in a great measure depend on the address and practice of the person who exhibits them.

TO MAKE A CAMERA OBSCURA.

Make a circular hole in the shutter of a window, from whence there is a prospect of the fields or street, or any other object not too near; and in this hole place a convex glass, either double or single, whose focus is at the distance of five or six feet.

Take care that no light enter the room but by this glass; at a distance from it, equal to that of its focus, place a pasteboard, covered with the whitest paper: which should have a black border to prevent any of the sides rays from disturbing the picture. Let it be two feet and a half long, and eighteen or twenty inches high; bend the length of it inwards, to form a part of a circle, whose diameter is equal to double the focal distance of the glass. Then fix it on a frame of the same figure, and put it on a moveable foot, that it may be easily fixed at

that exact distance from the glass where the objects paint themselves to the greatest perfection.

When it is thus placed, all the objects that are in the front of the window will be painted on the paper, in an inverted position, with the greatest regularity and in the most natural colours. If a moveable mirror be placed without the window, by turning it more or less, all the objects that are on each side of the window will appear on the paper. If instead of placing the mirror without the window you place it in the room, and above the hole (which must then be made near the top of the shutter), you may receive the repesentation on a paper placed horizontally on a table; and draw, at your leisure, all the objects that are there painted.

Nothing can be more pleasing than this experiment, especially when the objects are strongly enlightened by the sun: and not only land prospects, but a sea port, when the water is somewhat agitated, or at the setting of the sun, presents a very delightful appearance. This representation affords the most perfect model for painters, as well as for the tone of colours, as for that gradation of shades, occasioned by the interposition of the air, which has been so justly expressed by some of our modern painters.

The paper must have a circular form; for otherwise, when the centre of it is in the focus of the glass, the two sides will be beyond it, and consequently the image will be confused. If the frame were contrived of a spherical figure, and the glass were in its centre, the representation would be still more accurate. If the object without be at the distance of twice the focal length of the glass, the

image in the room will be of the same magnitude with the object.

The lights, the shades, and colours, in the camera obscura, appear not only just, but, by the images being reduced to a smaller compass, much stronger than in nature. Add to this, that these pictures exceed all others, by representing the motion of the several objects: thus we see the animals walk, run, or fly; the clouds float in the air; the leaves quiver; the waves roll, &c., and all in strict comformity to the laws of nature. The best situation for a dark chamber is directly north, and the best time of the day is noon.

The inverted position of the images may be deemed an imperfection, but it is easily remedied: for, by standing above the board on which they are received, and looking down on it, they will appear in their natural position: or by standing before it, and placing a common mirror against your breast in an oblique direction, upon looking down in it, the images will appear erect, and will receive an additional lustre from the reflection of the glass. This also may be done by placing two lenses in a tube that draws out. And by placing a large concave mirror at a proper distance before the picture, the figures will appear before the mirror, in the air, and in an erect position.

To magnify small objects by the sun's rays, let the rays of light that pass through the lens in the shutter, be thrown on a large concave mirror, properly fixed in a frame. Then take a slip or thin plate of glass; and sticking any small object on it, hold it in the incident rays, at a little more than the focal distance from the mirror: and the image of

that object will appear on the opposite wall amidst the reflected rays, very large and extremely clear and bright. This experiment never fails to give the spectator the highest satisfaction.

CONSTRUCTION OF THE MAGIC LANTERN.

This ingenious instrument is so well known, that it is almost needless for us to explain its object, which is, to represent, in a dark place, on a white wall or cloth, a succession of enlarged figures, of remarkable, natural, or grotesque objects. Nothing, perhaps, ever excited more wonder than this instrument, when first exhibited. Even to this day, it is a popular instrument of domestic entertainment; and is a sourse of profit to many wonder-working foreigners, who perambulate the country, to amuse the king's people by the astonishing exhibition of the Galanti show.

The magic lantern consists of a tin box, six inches square, or any other similar dimensions, with a funnel on the top, and a door on one side of it. This funnel being bent, serves the double purpose of letting out the smoke, and keeping in the light. In the middle of the bottom of the box is placed a moveable tin lamp, which must have two or three good lights, at the height of the centre of the polished tin reflector. In the front of the box, opposite the reflector, is fixed a tin tube, in which there slides another tube. The sliding tube has at its outer extremity a convex lens, of about two inches diameter; the other tube has also a convex lens fixed in it, of three inches diameter. The focus of the smaller of these lenses may be about five inches.

Between the fixed tube and the lamp, there must be a slit or opening to admit of the passage of glass sliders, mounted in paper or wooden frames; upon which slides it is that the miniature figures are painted, which are intended to be shown upon the wall.

The distinctness of the enlarged figures depends not only upon the goodness of the magnifying glasses, but upon the clearness of the light yielded by the lamp.

Such is the construction of the magic lantern, an instrument which is capable of yielding much amusement, which may be easily made, or may be bought ready made, with a set of painted slides, at any price.

HOW TO RESTORE A DEAD FLY TO LIFE.

This wonderful experiment, like many others, is very simple. Take a fly that has been drowned in water or spirits, place it in the sun, and cover it with salt or pounded chalk; in a short time (sometimes in a few minutes, at others, in an hour), it will revive and fly away. It is necessary that the fly be not squeezed when it is taken from the water.

A CURIOUS SECRET TO MAKE A CARD PASS FROM ONE HAND INTO THE OTHER.

Take two aces, the one of spades, the other of hearts; then put on that of spades the mark of

hearts, and on that of hearts, the mark of spades: which you will easily do, by splitting a card of each colour, when you are to cut out with dexterity, in order that the mark may be very neat; then rub lightly on the back of the spade and heart that you have cut, a little soap, or very white pomatum, then put the mark of hearts on the ace of spades, and the mark of spades on the ace of hearts; taking care to cover them completely, and to make all your preparations before you begin your experiments.

Divide your pack of cards in two parcels, and under each parcel you must put one of your two aces thus prepared, afterwards, take, with your right hand the parcel under which is the ace of hearts, and with your left that where your ace of spades is.

You will then show to the company that the ace of hearts is on the right hand, and the ace of spades on the left; when every body is convinced of it, you are to say, ladies and gentlemen, I am going to command the ace of hearts, which is in my right hand, to pass to my left, and the ace of spades to take its place. You may even propose to have both yours arms tied, to prevent their joining and communicating.

All the secret consists only in making a movement and stamping your foot, when you give your command: during this movement and stamping of your foot, you slip with dexterity your little finger on each of the marks, in order to rub off, and make the marks of spades and hearts, that were sticking on the two cards by the means explained before fall, without any body perceiving it: then you will

shew to the company that the cards have obeyed your command by passing from the right to the left, and from the left to the right, without your hands communicating.

This trick, done with dexterity and subtilty, will appear very singular, although it is in reality very simple.

TO RENDER HIDEOUS THE FACES OF ALL THE COMPANY.

Dissolve some salt and saffron in some spirits of wine; dip a little tow in it, and set fire to it. At this light, those who are of a fair complexion will appear green, and the red of the lips and cheeks will turn to a deep olive colour.

HOW TO MAKE A BAROMETER.

The common barometer consists of a glass tube about thirty-four inches in length, and from one-fourth to one-half of an inch in width, the wider the better: the top of this is closed and the bottom is open. The tube should be new, and perfectly clean within, and in order that this may be the case, it should be hermetically sealed at both ends, at the glass house, when it is made; when it is to be filled one end of it can be very easily cut off with a file. Supposing you to have the tube, the next thing required is pure mercury, without which it is impossible to make a barometer worth any thing. To fill the tube, take a small funnel of glass or paper, and pour the mercury through it in a fine con-

tinued stream, till it reaches within an inch of the top; as the tube fills, bubbles of air will gather in various parts, which it is impossible to avoid. It is possible, however, to clear these bubbles away; to do this, apply the finger hard against the open end of the tube, when you have nearly filled it as above directed and slowly invert it. This proceeding causes the air in the open end to rise gradually through the mercury, gathering in its way all the air in the tube. Then slowly turn up the tube, and observe if any bubbles remain, should there be any, the inverting of the tube must be repeated till that is the case no longer. When the air is all out of the tube, the filled part will appear like a fine polished steel rod. When this operation is completed, pour in more mercury to fill the tube to the top; then, stopping the orifice again with the finger, invert the tube, and immerse the finger and end, whilst stopped, in a basin of mercury; which basin, like the tube, is the better the wider it is. When the end of the tube is perfectly plunged under the surface of the mercury, the finger must be taken away, and the mercury in the tube will subside till its surface is from twenty-eight to thirty-one inches above the surface of the mercury in the basin. The exact height varies according to the pressure of the atmosphere at the time. The space at the top of the tube is a perfect vacuum. The next step is to fix this tube, with the basin below it, in the best manner you are able, to a suitable frame. Then measure from the surface of the mercury in the basin, twenty-eight inches upwards, and draw a line on the frame: measure also thirty-one inches from the mercury, and make another mark; then

divide the space of three inches between the two marks, into inches and tenths and hundredths of inches; and let there be a sliding index to point to these divisions.

This scale will answer all the ordinary purposes of a stationary barometer. The chief things to be attended to by those who wish to have a good barometer are the following:—

To have a wide tube and a wide basin; to have the mercury pure and the glasses clean; that the bottom of the tube be cut of obliquely, in order that when it rests on the bottom of the basin there may be a free passage for the mercury; that, to have the quicksilver quite free from air, it is best to boil it in the tube.

HOW TO FORETEL THE CHANGES OF THE WEATHER BY MEANS OF THE BAROMETER.

Notwithstanding that the phenomena of the barometer are extremely various, yet its action has in a great measure been reduced to rules, by the careful observance of which we are enabled to foresee the changes which, within some short time, are to take place in the weather.

1. The rising of the mercury presages, in general, fair weather; and its falling, foul weather, as rain, snow, high winds, and storms.

2. In very hot weather, the falling of the mercury indicates thunder.

3. In winter the rising presages frost; and in frosty weather if the mercury falls three or four divisions, there will certainly follow a thaw. But

in a continued frost, if the mercury rises, it will certainly snow.

4 When foul weather happens soon after the falling of the mercury, expect but little of it; and on the contrary, expect but little fair weather when it proves fair shortly after the mercury has risen.

5. In foul weather, when the mercury rises much and high, and so continues for two or three days before the foul weather is quite over, then you may expect a continuance of fair weather to follow.

6. In fair weather, when the mercury falls much and low, and thus continues two or three days before the rain comes: then expect a great deal of wet, and probably high winds.

7. The unsettled motion of the mercury denotes uncertain and changeable weather.

8. You are not so strictly to observe the words engraved on the plates, as the mercury's rising and falling; though in general it will agree with them. For if it stands at much rain and then rises up to changeable, it presages fair weather; though not to continue so long as if the mercury had risen higher. And so, on the contrary, if the mercury stood at fair, and falls to changeable, it presages foul weather; though not so much as if it had sunk lower.

From the most accurate observations of the motions of the barometer, and consequent changes of the air in this country, the following conclusions have been drawn.

1. In winter, spring, and autumn, the sudden falling of the mercury for a large space, denotes high winds and storms; but in summer it denotes heavy showers, and often thunder; and it always

sinks lowest of all for great winds, though not accompanied with rain; though it falls more for wind and rain together than for either of them alone.

2. After rain if the wind change to any part of the north, with a clear dry sky, and the mercury rise, it is a certain sign of fair weather.

3. After very great storms of wind, when the mercury has been low, it commonly rises again very fast. In settled fair dry weather, except the barometer sink much, expect but little rain; for its small sinking then is only for a little wind, or a few drops of rain; and the mercury soon rises again to its former station. In a wet season, suppose in hay time and harvest, the smallest sinking of the mercury must be minded; for when the constitution of the air is much inclined to showers, a little sinking in the barometer then denotes more rain, as it never then stands very high. And if, in such a season, it rise suddenly very fast and high, expect not fair weather more than a day or two, but rather that the mercury will fall again very soon, and rain immediately follow: the slow gradual rising, and keeping on for two or three days, being most to be depended on for a week's fair weather; and the unsettled state of the quicksilver always denoting uncertain and changeable weather, especially when the mercury stands any where about the word changeable on the scale.

4. The greatest heights of the mercury in this country, are found upon easterly and north-easterly winds; and it may often rain or snow, the wind being in these points, and the barometer sinks little or none, or it may even be in a rising state, the effect of those winds counteracting. But the mer-

cury sinks for wind, as well as rain, in all the other points of the compass; but rises as the wind shifts about to the north or east, or between those points; but if the barometer should sink with the wind in that quarter, expect it soon to change from thence: or else, should the fall of the mercury be much, a heavy rain is then likely to ensue, as it sometimes happens.

It is to be observed, that it is not so much the absolute height of the mercury in the tube that indicates the weather, as its motion up and down, and therefore, to pass a right judgment of what weather is to be expected, we ought to know whether the mercury is actually rising or falling; to which end the following rules are of use.

1. If the surface of the mercury is convex, standing higher in the middle of the tube than at the sides, it is a sign that the mercury is then rising.

2. But if the surface is concave, or hollow in the middle, it is then sinking.

3. If it be plain, or rather a very light convex, the mercury is stationary; for mercury being put into a glass tube, especially a small one, naturally had its surface a little convex, because the particles of mercury attract one another more forcibly than they are attracted by glass.

4. If the glass be small, shake the tube; then if the air be grown heavier, the mercury will rise about half a tenth of an inch higher than it stood before; but if it be grown lighter, it will sink as much.

CALCULATION OF THE PRESSURE OF THE ATMOSPHERE UPON A MAN'S BODY.

A column of mercury of twenty-nine and a half inches high, and one inch in thickness, weighs just fifteen pounds, consequently, the air presses with a weight equal to fifteen pounds upon every square inch of the earth's surface; and 144 times so much, or 2160 pounds upon every square foot.

Reckoning the surface of a middle-sized man to be about 14 square feet, he sustains a pressure from the air equal to 30,240 lbs. troy, or 11 tons 2 cwt. and 18½ lbs. It may be asked, how it happens that we are not sensible of such a great pressure? The reason is, that such pressures only are perceived by us, as move our fibres, and put them out of their natural situations. Now the pressure of the air is equal on all parts of the body, and it is balanced by the spring of the air contained in the body; therefore it cannot possibly displace any of the fibres, but, on the contrary, braces and keeps them all in their relative situations. But if the pressure be removed from any particular part, the pressure on the neighbouring parts immediately becomes sensible.

Thus, if we take a receiver open at the top, and cover it with the hand upon exhausting the receiver, and thereby taking off the pressure from the palm of the hand, we shall feel it pressed down by an immense weight, so as to give pain that would soon be insupportable, and endanger the breaking of the hand.

A SIMPLE BAROMETER.

Take a common phial, and cut off the rim and part of the neck. This may be done by a piece of whip-cord, twisted round it, and pulled to and fro quickly, in a sawing position, by two persons; one of whom holds the phial firmly in his left hand. Heated in a few minutes by the friction of the string, and then dipped suddenly into cold water, the bottle will be decapitated more easily than by any other means.

Let the phial be now nearly filled with common pump-water, and, applying the finger to its mouth, turn it quickly upside down; on removing the finger it will be found that only a few drops will escape.—Without cork, or stopper of any kind, the water will be retained within the bottle by the pressure of the external air: the weight of air without the phial being greater than that of the small quantity of water within it. Now let a bit of tape be tied round the middle of the phial, to which the two ends of a string may be attached, so as to form a loop to hang on a nail; let it be thus suspended, in a perpendicular manner, with the mouth downwards; and this is the barometer.

When the weather is clear, and inclined to be so, the water will be level with the section of the neck, or rather elevated above it, and forming a concave surface. When disposed to be wet, a drop will appear at the mouth, which will enlarge till it falls, and then another drop, while the humidity of the atmosphere continues.

TO MAKE SUGAR FROM OLD RAGS.

The conversion of starch, wood, and even rags, into sugar, will no doubt surprise persons unacquainted with chemical research, but nothing can be more true. The chemical constituents of these different substances differ but little. The abstraction of a small portion of the carbon and hydrogen from starch converts it into sugar. By digesting potatoes with diluted oil of vitriol, for a day or two, at a temperature of 212° Fahrenheit, afterwards removing the acid by chalk, and concentrating the strained liquor by evaporation, chrystals of sugar will be obtained.

Saussure produced 110 parts of sugar from 100 parts of starch, from which he concluded that sugar was a peculiar compound of water and starch. Mr. Braconnet treated elm dust with oil of vitriol in the same manner as starch, neutralizing the acid with chalk, and obtained a liquor which became gummy on evaporation. By triturating linen rags in a glass mortar with sulphuric acid, a similar gum is produced. If the gummy matter is boiled with diluted oil of vitriol, a chrystallizable sugar is obtained.

THE DIVING-BELL.

The invention of the diving-bell is generally assigned to the sixteenth century. Those who had no idea of this machine, Mr. Beckman says, might have been easily led to it by the following experiment. If a drinking glass inverted be immersed in

water, in such a manner that the surface of the water may rise equally round the edges of the glass, it will be found that the glass does not become filled with water, even when pressed down to the greatest depth; for, where there is air, no other body can enter, and by the above precaution the air cannot be expelled by the water. In like manner, if a bell of metal be constructed, under which the diver can stand on a stool suspended from it, so that the edge of the bell may reach about to his knee, the upper part of his body will be secured from water; and he can, even at the bottom of the sea, breathe the air enclosed in the bell.

The oldest information which we have respecting the use of the diving-bell in Europe, is the relation of an exhibition at Toledo, before the Emperor Charles the Fifth, in 1538; when two Greeks, in the presence of several thousand spectators, let themselves down under water in a large inverted kettle, with a burning light, and rose up again without being wetted. It is described more than once in the words of Lord Bacon, who explains its effects; and remarks, that it was invented to facilitate labour under the water.

In the latter part of the seventeenth century, the diving-bell appears to have been employed in undertakings of importance; particularly in attempts to recover various articles from the remains of that portion of the Spanish armada which was wrecked on the western coast of Scotland, In the year 1665, a person was so fortunate as to bring up some cannon, which, however, were not sufficient to defray the expenses. Of these attempts, and the

kind of diving-bell used, an account was given by a Scotch writer of the name of Sinclair.

Some years after attempts of the like kind were renewed. A man of the name of Phipps, formed a project for searching and unloading a rich Spanish ship, which had been sunk upon the coast of Hispaniola; and represented his plan so successfully to Charles II. that the king gave him a ship, and furnished him with every thing necessary for the undertaking. He set sail in 1683, but returned without success, though with a firm conviction of the possibility of his scheme. In 1687, Phipps, under new patronage, made another endeavour, and at last succeeded in weighing up so much treasure, that he returned to England with the value of two hundred thousand pounds sterling.

The attention of the learned, in different countries, was now turned to the diving-bell, the construction and use of which appears to have been understood by one Witzen, in 1671.

The great improver of diving-bells, however, in this country, was Dr. Edmund Halley. The bell which he constructed about 1717, was three feet broad at the top, five feet at the bottom, and eight feet in height; forming a cavity of sixty-three cubic feet. It was covered with lead, and was so heavy that it sunk to the bottom even when entirely empty: weights also were disposed round the lower edge, so as ensure its sinking in a perpendicular direction. In the top was fixed a piece of strong glass to admit light, and likewise a valve to give a passage to the air corrupted by the breath. Around the inner circumference of the bell was placed a seat for the divers; and a stool fixed to

ropes hung below, on which they could stand in order to work. The whole machine was suspended from a cross-beam made fast to the mast of a ship. That the bell might be supplied with fresh air, under the water, large vessels, filled with air, and which had an opening below, through which the water compressed the enclosed air, were let down by ropes. In the top of these vessels were leathern pipes besmeared with oil, through which the diver introduced air from the vessels into the bell. The bell was thus supplied in such abundance, that Dr. Halley, and four other persons remained under water for an hour and a half, at the depth of ten fathom, without suffering the least injury. When the empty air-vessels were drawn up, the Doctor sent his order written upon a sheet of lead with an iron spike. Dr. Halley also invented a leaden cap, in the shape of a bell, which being placed so as to cover the diver's head, enabled him to leave the greater bell when at the bottom. A thick pliable pipe, which conveyed air from the greater bell, served also as a clue to the diver to find his way back.

The last great improvement of the diving-bell, was by Mr, Spalding, of Edinburgh, by whose contrivance several defects, which appeared in the construction of Dr. Halley's bell, were remedied. The sinking or raising of the bell was made no longer to depend entirely on the people at the surface of the water; and the contrivance of a balance-weight obviated the danger of being overset by the rugged prominence of concealed rocks, to which Dr. Halley's bell was liable.

BIRD-LIME.

The common method is to peel a good quantity of holly-bark about midsummer, fill a vessel with it, put spring water to it, boil it till the grey and white bark arise from the green, which will require twelve hours boiling; then take it off the fire, drain the water well from it, separate the bark, lay the green bark on the ground in some cool cellar covered with any green rank weeds, such as dock, thistles, hemlock, &c., to a good thickness; let it lie fourteen days, by which time it will be a perfect mucilage; then pound it well in a stone mortar till it becomes a tough paste, and that none of the bark be discernible; next after wash it well in some running stream, as long as you see the least motes in it; then put it into an earthen pot to ferment, scum it four or five days as often as any thing rises, and when no more comes, change it into an earthen pipkin, add a third part of capon's or goose grease to it, well clarified, or oil of walnuts, which is better, incorporate them on a gentle fire, and stir it continually until it is cold, and thus it is finished.

HOW TO USE BIRD LIME.

When lime is cold, take your rods and warm them a little over the fire: then take your lime and wind it about the top of your rods, then draw your rods asunder one from another and close them again, continually plying and working them together, till by smearing one upon another, you have equally

bestowed on each rod a sufficient proportion of lime.

OF CATCHING SMALL BIRDS IN BUSHES WITH LIME TWIGS.

The great lime-bush is best for this use, which you must use after this manner; cut down the main branch or bough of any bushy tree, whose branch and twigs are long, thick, smooth and straight, without either picks or knots, of which the willows or birch trees are the best; when you have picked it and trimmed it from all superfluity, making the twigs neat and clean, then take the best bird lime, well mixed and wrought together with goose grease, which being warmed, lime every twig therewith within four fingers of the bottom.

A SECRET TO HINDER PIGEONS FROM QUITTING A PIGEON HOUSE.

Take the head and feet of a gelt goat, and boil them together till the flesh separates from the bone; take this flesh and boil it again in the same liquor, till the whole is consumed; bruise into this decoction, which is very thick, some potter's earth out of which you are to get all the stones, vetch dung, hemp, soot, and corn; the whole must be kneaded together, and reduced to a paste or dough, which form into small loaves about the thickness of two fists, and dry them in the sun or oven, and take care they do not burn; when they are baked, lay them in several parts of the pigeon house, as soon

as they are set there the pigeons will amuse themselves with pecking them, and finding some taste therein which pleases them, they will keep so close to it that they will not afterwards leave it but with regret. Others get a handful of salt, which they candy, and afterwards put into the pigeon-house. Some take a goat's head and boil it in water, with salt, cummin, hemp, and urine; and then expose it in the pigeon house, with which they amuse themselves. Lastly, there are those who fry millet in honey, and add a little water thereto to prevent its burning: this preparation is a repast to them, and will cause them to have such an affection for their ordinary habitation, that they will be so far from abandoning it themselves, that they will draw strange pigeons to it.

BIRDS AND FOWL OF ALL SORTS.

Get seeds, (all sorts that fowl love) and lay them to soak in lees or mother of wine, strew them where they come, and them will fox them, so that you may take them with your hands.

THE ART OF PAINTING IN OIL.

WHITES.

The principal of all whites is white lead. Of this colour there are two sorts, the one called ceruse, which is the most pure and clean part, the other is called by the plain name of white lead.

Besides white lead and ceruse, there is another sort to be met with sometimes, which they call flake white.

BLACKS.

Lamb black. Lamp, or candle black. Ivory black. Willow charcoal.

REDS.

Vermilion is the most delicate of all light reds, being of itself a perfect scarlet colour.

Lake, especially the richest sort, is the best of all dark reds, being the most pure crimson.

Red lead is the lightest of all leads now in use; it is a sandy, harsh colour, and such a one as is not easily ground very fine, although you bestow much labour on it.

Spanish Brown is a dark dull red, of a horse flesh colour; it is a earth, it being dug out of the ground, but there is some very good colour, and pleasant to the eye, considering the deepness of its colour; it is of great use amongst painters, being generally used as the first or priming colour, that they lay upon any sort of work, being cheap and plentiful, and a colour that uses well, if it be ground fine, as you may do with less labour than some better colours do require; the first sort is the deepest colour, and free from stones; the other sorts are not so good as to give a colour to the eye, but yet they serve as well as any other for a priming colour.

YELLOWS.

Yellow ochre is of two sorts, one called plain ochre, the other spruce ochre, the one is a much lighter colour than the other.

Pink yellow.

Orpiment is that colour which some call yellow arsenic.

Masticote is a good light yellow for most uses, especially in making greens, of which several sorts may be framed out of this colour, being mixed with blue.

GREENS.

Verdigrease is the best and most useful green of all others.

Green bice is of a sandy nature, and therefore not much used; green verditer is also of a sandy colour; neither of them bear any good body, and

are seldom used but in landscapes, where variety is required.

BLUES.

Blue bice bears the best body of all bright blues used in common work, but it is the palest colour.

Blue verditer is a colour of no good body, but something sandy, and of no very good colour itself, being apt to turn greenish, and being mixt with a yellow produces a good green.

Indigo is a deep blue, if wrought by itself, to remedy which, whites are usually mixt, and then it is but a very faint blue.

Note, that the longer this colour is ground, the more beautiful and fair it looks.

Smalt is the most lovely blue of all others. Of this colour there are two sorts, the finest is that which is called oil smalt.

Umber is a colour that really has no affinity with the others above mentioned, being neither white, black, red, yellow, blue or green, yet it is a colour of as great use as any of the rest used in common painting.

THE PRACTICE OF WORKING OIL COLORS, AND PAINTING TIMBER WORK AFTER THE MANNER OF COMMON PAINTING.

That which is here called common painting is only the way and manner of colouring all manner of wainscoat, doors, windows, posts, rails, pales, &c., or any materials that require either beauty or preservation from the violence of the rain, or injury of

weather; the method of doing which, I shall lay down as plain as I can. Suppose then, that there be a set of pallisadoes, or a pair of gates, or some posts and rails to paint, and are to be finished in a stone colour, first look over the work, and take notice whether the joints be open in the gates, or if there be any large clefts in the posts, for if these are not secured the wet will insinuate itself into these defects, and make the quicker dispatch in ruining the whole; let the first business therefore be, to stop up these places smooth and even, with a putty made of whitening and linseed oil, well beaten together on the grinding stone with a wooden mallet, to the consistency of a very stiff dough, and with this let all the crannies, clefts, and other defects be perfectly filled up, that it may be equal to the surface of the stuff, then proceed to the priming of the work with some Spanish brown well ground and mixed with some very thin linseed oil; with this do the whole over, giving it as much oil as it will drink up; this in about two days will be indifferently dry, then if you would do it substantially, do it over again with the same priming colour; when this is thoroughly dry, then with the white lead, well ground and tempered up, not too thin, for the stiffer you use it, the better body will be laid on, and the thicker coat of colour that your timber is covered withal the longer it will last; let this coat of colour be well rubbed on, and the whole surface be so entirely covered that there remains no creak or corner bare, which you may easily do by jobbing in the point of a bristle brush; let this first colouring dry, and then go over it a second time, and if you please

a third also; the charge will be a little more, but the advantage will be much greater.

Now he that is able to bring the work thus far on, has proceeded to the highest pitch of that of common painting, and that aims at preservation as well as beauty; but this is not all, for he that has arrived thus far is in a fair way to the other perfections in the art of painting; but the pannelling of wainscoat with its proper shadows, and for imitating olive and walnut wood, marble, and such like; these must be attained by ocular inspection, it being impossible to deliver the manner of the operation by precept without example, and I am bold to affirm, that a man shall gain more knowledge by one day's experience than by a hundred spent to acquire it some other way.

I advise therefore all those that desire any insight into this business, to be a little curious, if opportunity offers, in observing the manner of a painter's working, not only in grinding his colours, but also in laying them on, and working them in: in all these observing the motion of his hand in managing any kind of tool, and by this means, with a little imitation, joined to the directions here given, I doubt not but in a short time you may arrive to great proficiency in the business of common painting.

Note, that if when you have made use of your colours, there be occasion for a small cessation till the whole is finished; in this case it is best to cover the colours in your pot with water, for that will prevent their drying, even in the hottest time.

And for your pencils, they ought so soon as you have finished, to be well washed out in clean lin-

seed oil, and then in warm soap suds; for if either oil or colours be once dried in the rush or pencil, it is spoiled for ever.

It has been observed, that in timber laid over with white when it has stood some time in the weather, the colour will crack and shrink up together, just as pitch does, if laid on anything that stands in the sun; the cause of this is, that the colour was not laid on with a stiff body, able to bind itself on firm and fast.

If you have at any time occasion to use either brushes that are very small, or pencils, as in many cases there will be occasion, you ought then to dispose of the colours you use upon a pallet, (which is a wooden instrument, easy to be had at any colour shop) and there work and temper them about with your pencil, that the pencil may carry away the more colour; for you are to note, that if a pencil be only dipt into a pot of colour, it brings out no more with it than what hangs on the outside, and that will go but a little way; whereas, if you rub the pencil about the colour of the pallet, a good quantity of colour will be taken up in the body of the pencil; and besides all this you may bring your pencil better to a point on a pallet, than you can do in a pot; the point of a pencil being of the greatest use in divers cases, especially in drawing lines and all sorts of flourishing.

WHAT COLOURS ARE SUITABLE AND SET OFF BEST ONE WITH ANOTHER.

By setting off best, I mean their causing each other to look more pleasant, for two of some particular

colours put together, or one next the other, shall add much to the beauty of each other, as blue and gold, red and white, and so on; but green and black put together, are not so pleasant, neither doth black and umber, or haw colour, appear so well.

All yellows then set off best with blacks, and blues, and with reds.

All blues set off best with whites and yellows.

Greens set off well with blacks and whites.

Whites set off well enough with any other colour.

Reds set off best with yellows, whites and blacks.

Gold looks well upon a white ground, especially if the matter to be gilt be carved.

Gold and black shews also very well.

Gold on timber colour shews also very well.

So does gold and horse flesh colour, made with the brightest Spanish brown.

But the most glorious grounds of all others for gold, are vermilion red, the smalt blue, and the lake laid on a light ground.

OF SOME COLOURS THAT ARISE FROM MIXTURE.

Ash colour is made of white lead and lamb black; if a deep ash colour, then take the more black, if a light one, then but little, and more white.

A lead colour is made of indigo and white.

A colour resembling new oaken timber, is made of umber and white lead.

A flesh colour is compounded of lake, white lead, and a little vermilion.

A buff colour, yellow ochre and red lead.

For a light willow green, verdigrease and white.

For a grass green, verdigrease and pink.

A carnation is made of lake and white.

Orange colour, yellow ochre and red lead.

A light timber colour, mix spruce ochre and white, and a light umber.

Brick colour, red lead, white and yellow ochre.

For a straw colour, white lead and a little yellow ochre.

Olive wood is imitated with ochre and a little white veined over with burnt umber.

Wall nut tree is imitated with burnt umber and white, veined over with the same colour alone, and in the deepest places with black.

Pales and posts are sometimes laid over with white, which they call a stone colour.

Sometimes posts and pales are laid over with indigo and white, which is called a lead colour.

Window frames are laid in white, if the building be new, but if not, they are generally laid in lead colour, or indigo and white, and the bars with red lead.

Doors and gates, if painted in pannels, then the shadows of a white ground, are umber and white; but if laid in lead colour, then the shadows are listed with black.

'Tis not possible to set down all those varieties of colours that may be produced by mixture.

GILDING.

TO MAKE GOLD AND SILVER SIZE.

THE operation is thus for making gold size; get yellow ochre, and grind it on a stone with water till it be very fine, afterwards lay it on a chalk stone to dry; this is the common way; or wash your ochre, for when it is washed, be sure nothing but the purest of the colour will be used; and besides, it is done with less daubing.

When your oil and ochre are thus prepared, you must grind them together as you do other oil colours, only with fast drying oil, but it is somewhat more laborious, and must be ground very fine, even as oil itself; for the finer it is, the greater lustre will your gold carry that is laid on it.

Here note, that you must give it such a quantity of your fast oil, that it may not be so weak as to run when you have laid it on; nor so stiff that it may not work well; but of such a competent body, that after it is laid on, it may settle smooth and glossy, which is the chief property of well made good size.

Silver size is made by grinding white lead with fast drying oil, some adding a little verdigrease to make it bind.

TO GILD WITH GOLD, EITHER LETTERS OR FIGURES.

Whatever you would gild must be drawn with good size, according to the true proportion of what you would have gilt, whether figure, letter, or whatever else it be; when you have thus drawn the true proportion of what you would have gilt, let it remain till it be sufficiently dry to gild upon, (which you shall know by touching it with the end of your finger,) for if your finger sticks a little to it, and yet the colour comes not off, then it is dry enough, but if the colour comes off on your finger, then it is not dry enough, and must be let alone longer; for if you would then lay your gold on, it would so drown it, that it would be worth nothing; but if your size should be so dry as not to hold your finger as it were to it, then it is too dry, and the gold will not take; for which there is no remedy but new sizing; therefore you must watch the true time, that it be not too wet or too dry; both extremes being not at all convenient.

When your size is ready for gilding, get your book of gold leaf, and opening a leaf of it, take it out with your cane plyers, and lay it on your gilding cushion, and if it lie not smooth, blow on it with your breath, which will lay it flat and plain, then with a knife of cane, or for want of it, an ordinary pocket knife, that has a smooth and sharp edge; with this (being wiped very dry on your sleeve, that the gold stick not to it) let your leaf gold be cut

into such suitable pieces or forms as your judgment shall think most suitable to your work.

When you have thus cut your gold into convenient forms, then take your gilding pallet, ('tis a flat piece of wood, about three inches long and an inch broad, upon which is glewed a piece of fine woollen cloth of the same length and breadth) and breathe upon it to make it dampish, that the gold may stick to it; with this tool take your gold (by clapping it down according to discretion,) and your gold must afterwards press down smooth with a bunch of cotton, or a hare's foot; and thus you must do piece by piece till you have covered all your gold size; and after it is fully dried, then with your hare's foot brush off all the loose gold, so will your gilding remain fair and beautiful.

If your work to be gilt be large, open your book of leaf gold, and lay the leaf down on your work without cutting it into pieces, and so do leaf by leaf till you have covered quite over what you intend to gild; and if some particular places should miss there, take up with a small bunch of cotton, a piece of gold leaf, cut to a fit size, and clap it on, that the whole may be entirely covered; if the gold is to be laid in the hollows of carved work, you must take it up on the point of a camel's hair pencil, and convey it in, and with the said pencil dab it down till it lie close and smooth.

HOW TO GILD WITH SILVER.

In laying on silver upon an oily size, the same method in all respects is required as for gilding with gold, save only in this, that the size, upon which

silver is laid, ought to be compounded of a very little yellow ochre, and much white lead; for the size being of a light colour, the silver laid on it will look more natural, and retain its own colour better, the whiter the size is.

Note.—That the common painters do now generally in gilding, use more silver than gold, in most works that are not much exposed to the air, to which they afterwards give the colour of gold with a lacquer varnish, made of gum lake, dissolved in spirits of wine, and laid over it.

THE ART OF PAPER-MAKING.

The origin of the art of paper making is involved in considerable obscurity; but from the closest investigations into the subject by antiquaries, it would appear that it was known and practised in China upwards of two thousand years ago. From China it is said to have found its way into Persia, from Persia to Arabia, and from Arabia to Spain, into which it was introduced by the Moors. From Spain, a knowledge of the art spread to France about the year 1260, to Germany in 1312, and it is known to have been in England about the year 1320.

The Chinese made their paper of silk or bamboo reduced to a pulp; the Arabs did not follow this practice, but formed their paper of cotton; and the Spaniards were the first who tried the process with linen substances.

In the present day the greater pat of the writing and printing papers in this and other countries is manufactured from linen rags, cut down, and reduc-

ed with water to a pulp. Papers of a coarser fabric are made from old ropes, cotton waste, and other vegetable matter; lately we saw a remarkable fine specimen of brown packing paper made from the refuse of mangel wurzel. The rags forming the basis of nearly all the best English and Scotch papers are imported in bags from Bremen and Hamburg, also from different ports in the Mediterranean. These rags are sorted of various qualities, and from their appearance they seem to have composed the garments of the females in those countries whence they are derived. The rags composing the paper on which the present work is printed are imported from Bremen and Hamburgh, to which places they have been brought by travelling Jew merchants and others from most parts of the north of Europe. English rags are generally less substantial in fabric and sell at a much lower price than those of the above places: they consequently make a paper weaker in fabric, and this insubstantiality is sometimes farther increased by the admixture of cotton and other inferior substances.

Until comparatively recent times, all kinds of paper were made by tedious and expensive process. The rags being reduced to a pulp, the matter was lifted in sieves by the hands of a workman, sheet after sheet, a practice now entirely disused, except in coarse and some descriptions of writing paper. The greater part of the writing, and almost the whole of the printing papers manufactured in Great Britain are now made by machines, according to a method invented by the Messrs. Fourdrinier, who may be considered the Arkwrights of paper-making, which is as follows:—

After the rags have arrived in the premises, the first operation is that of picking and sorting them into different heaps, according to the quality of the paper intended to be made from them. They are then cut into small pieces of as equal a size as possible, being four or five inches square. This is done by the hand, by large broad knives fixed into a board or table, like that in a joiner's workshop. The back of the knife is towards the cutter, and is placed in a sloping position backwards from the heel to the point. This operation, as well as the previous ones, is executed by women, and cutting a hundred weight is reckoned a fair day's work. After being cut, the rags are put into the dusting machine, a large circular wire sieve, which being made to revolve rapidly, effectually cleanses the rags from any dust or loose matter adhering to them. After this they are put into troughs and boiled for a certain time (according the size of the boiler), both to cleanse them more thoroughly, and to soften them; and from thence they are lifted with a copper gripe, and carried in boxes to the first washing-machine. The latter consists of a large oblong stone trough, into which, during the process of manufacturing, a continued stream of water is allowed to run, and being permitted to escape at the same time by a different outlet, it is kept in a manner always fresh and pure. On one side of the trough is erected the machine, which, as it serves the purpose both of washing and grinding the rags, is termed by the operatives the breaking-in engine. It is of very simple construction, consisting of a roller revolving by machinery horizontally over the surface of a closely and sharply grooved plate, by which

the rags are torn in shreds. The continued gush of water into one end of the trough keeps the contents continually revolving, while at the bottom are placed agitators for preventing any part subsiding to the bottom; and thus the whole is gradually and equally reduced to a sort of pulp. After being sufficiently ground and washed in this manner, which occupies about an hour and a half, the stuff is passed down by boxes communicating with the trough to the bleaching boxes, each of which is formed to hold a hundred weight of rags after being reduced to the state described. And we ought perhaps before to have mentioned, that the rags being all exactly weighed when dry, and previous to being subjected to any process whatever, the proper quantity of stuff is afterwards easily regulated in passing from one department to another. It has been found that a quantity of stuff, which in its original state would have amounted to one hundred weight of rags, is found most suitable for bleaching. The bleaching-liquor consists simply of a strong solution of lime.

After bleaching for twelve hours, the stuff is again put into a washing-machine, for the purpose of cleansing it thoroughly from the bleaching-liquor. This process is exactly similar to that previously described, the only difference being, that in the latter the roller (which is in both regulated by a screw) is brought closer to the horizontal plate above described, and thus reduces the stuff to a finer quality. It is here also that the size—the addition or the want of which, as is well known, constitutes the chief difference between paper for the reception of ink and the other sorts—is added to the stuff

with the exception of that intended for the finer sorts of writing-paper, which is all sized by the hand (called tub-sizing) after being manufactured.

From the second washing machine the stuff is passed down to a large tun, like a brewer's vat, called the stuff-chest; being merely a reservoir for holding the liquid, which now bears the closest resemblance to soured or curdled milk, preparatory to being let into the machine where it is made into paper. In the bottom of it are agitators, which keep the liquid continually mixing, and thus preserving it in an uniform degree of thickness. From the chest the stuff is let out by a sluice into a pipe, which leaves it at one end of the machine, by which it is converted into paper; the opening whence it finally issues corresponding exactly in breadth to the machine. The quantity and thickness of the stuff admitted into the latter is regulated according to the kind of paper to be made, and this must be entrusted entirely to the experience of the workman.

The first part of the machinery upon which the stuff comes is a brass-wire cloth, of so fine a texture that there are seventy wires in the inch. It is woven, we understand, exactly in the same manner as linen. This wire-cloth may be described as a sort of belt without a break in it, which is kept continually revolving, but in such a way that the upper side, upon which the stuff is received, preserves a flat and horizontal surface. After passing between a pair of rollers, where it delivers the stuff, it is led backwards again under the frame, and so goes on in a continuous revolution. Upon the upper surface of the wire are placed moveable sides, which, by

being approached to, or drawn back from each other, regulate the breadth of the sheet to be manufactured; so that it can be made either the whole breadth of the wire-cloth, or otherwise, at pleasure. By an ingenious contrivance, too, an agitated horizontal motion, similar to that given to the sieve of a pair of fanners, is communicated to the wire-cloth on receiving the stuff, by which it is more equally distributed over the surface, and renders the paper of a uniform strength and thickness.

The first pair of rollers through which the stuff passes, are called the couching rollers. The under roller is simply cast-iron, while the upper one is rolled round with woollen cloth of a peculiar texture, manufactured for the purpose. It is upon this upper one that the stuff is delivered; and there are men stationed behind, where the wire leaves the rollers, with small sponges to lick it up from the wire and fix it to the roller when the machinery is first set a-going, and after which it adheres of itself. In going through the rollers, the stuff only undergoes a slight degree of compression; and it will be evident from their different kinds of surfaces, that it can only be pressed smooth on one side. To render both sides alike, therefore, what may now be called the sheet is transferred to another pair of rollers of the very same description, where the process is simply reversed by the rough side of the paper being pressed by the cast-iron roller. These last rollers are considerably closer than the first, and thus render the sheet more dry and firm. It often happens, when the sheet is passing from three rollers to the others that succeed them, that it breaks, and adheres to the woollen roller; in which event

should the broken parts be carried round on the surface of the roller, they would inevitably injure the part of the sheet that follows. In order to avert this casualty, there is affixed lengthwise along the upper surface of the roller, a large knife, resembling in breadth and sharpness a common scythe, the edge of which, being placed in a slooping manner, like the blades of a wright's plane, is placed so close to the roller, as effectually to shave it of any substance that may chance to adhere to it. This instrument is called the "doctor," and is found of the utmost utility.

After passing through one or two other pillars of rollers besides those just described, the sheet is passed on to the drying cylinders, of which there are two. They are hollow, and heated by steam introduced through pipes at each end of their axis. By various ingenious contrivances, they are ready means of letting off the extra steam, as well as for throwing out the water that gathers within the cylinder. The latter object is accomplished by means of an instrument shaped like a corkscrew, and is wrought by machinery. The first of these cylinders is of a cooler temperature than the one behind it, in order that the paper may be dried gradually. When either of them are too hot, it is at once seen by the shrivelling of the paper, when the temperature is immediately lowered by letting out the steam. From the last cylinder the sheet is forthwith transferred, after passing through an intervening pair of rollers to smooth it after drying, to the reeling frame, upon which it is wound, and the process is complete—the paper fit for immediate use.

It has taken us some time to detail the different

operations of this beautiful and extraordinary machine, although the whole process is gone through almost with the speed of thought. Some idea of its expedition may be gathered from the fact, that when working paper of the full breath of the machine, a quantity of stuff equivalent to six and twenty feet of what is called common demy paper, is let into it in the course of a minute! The whole machine is not more than twelve or thirteen feet in length, into one end of which we see a white liquid resembling butter-milk running in, and from the other comes forth a finished fabric, now become almost as important to mankind, in its various uses, as the art itself; and without which, indeed, the latter art would loose its chief value.

It is to be observed that no break or stop takes place during the process, unless what may happen from accidents. The whole goes on continuously and uninterruptedly, with scarcely the smallest exertion of manual labour. When we behold so great a triumph of mechanical art, one may almost be pardoned for doubting whether the wonderful machine jocularly hinted at by the Author of Waverley where undressed flax is put in at one end and comes out at the other in the shape of finished ruffled shirts, washed, dressed, and all, be altogether chimerical!

Another remarkable fact attending this invention remains to be added, namely, that the sheet of paper can be made of any given length—fifty miles at a stretch, if such an article were necessary, and did the size of the reel admit of it. From a paragraph, indeed, which not long since appeared in the public prints, noticing a commission lately sent to a paper-

maker to manufacture and send ten miles of a particular sort, it seems not at all improbable that orders may soon come to be generally given and executed on such terms.

The reeling process is not behind in any other department for ingenuity. It is a double reel, moveable upon an axis, and so contrived that when one reel has received a proper quantity of paper, the empty one is turned round into its place. The reeling process thus goes on uninterruptedly, while the operatives cut the paper upon the full reel into the suitable lengths and breadth, and thus have it ready for again receiving another complement. The method for ascertaining when the usual stated quantity has been put upon one reel, is by a signal given by a small machine, not bigger than a watch, the mechanism of which is connected with the reel. By hands on the dial-plate, too, it can be seen when the half, quarter, and so forth, of the reelful has been wound on, so that any given quantity of paper, and no more, may thus, when required, be cut off.

When the paper has been cut off the reel, it is carried to the finishing-house. Here it is first pressed, generally by a force-pump water-press. It is then carefully examined, and all the dirty or broken sheets picked out and put aside. It is afterwards assorted into quires and reams, and pressed over again: after which the parcels are ready for receiving the stamp of the exciseman. The fine writing paper is hot-pressed by placing a metal plate heated by steam betwixt every sixty or seventy sheets. A glazed pasteboard is put betwixt each sheet. After being taken out, it is carefully cut round the edges

with an instrument used by bookbinders, called a plough, and put up into separate reams.

The best writing-papers are, we believe, made in Kent, a district in which the water is pure, or free of particles of iron, which, when they occur, mark the sheets with brown spots. Good printing-papers are now made in all parts of Great Britain. Of late years great improvements have taken place in this branch of the manufacture, and we now rarely see a volume printed on bad paper. Paper making in Scotland is of a comparatively modern date: but in the present day the printing-papers made in this part of the United Kingdom compete with any manufactured in the south. One of the chief seats of the Scottish paper manufacture is on the river Esk, in Mid-Lothian.—*From Chambers' Edinburgh Journal.*

METHOD OF SOFTENING CAST-IRON.

It consists in placing it in a pot surrounded by a soft red ore, found in Cumberland and other parts of England, which pot is placed in a common oven, the doors of which being closed, and but a slight draught of air admitted under the grate; a regular heat is kept up for one or two weeks, according to the thickness and weight of the castings. The pots are then withdrawn, and suffered to cool; and by this operation the hardest cast metal is rendered so soft and malleable, that it may be welded together, or, when in a cool state, bent almost into any shape by a hammer or vice.

ELECTRICITY ON PLANTS.

It is very easy to kill plants by means of electricity. A very small shock, according to Cavallo, sent through the stem of a balsam, is sufficient to destroy it. A few minutes after the passage of the shock, the plant droops, the leaves and branches become flaccid, and its life ceases. A small Leyden phial, containing six or eight square inches of coated surface, is generally sufficient for this purpose, which may even be effected by strong sparks from the prime conductor of a large electrical machine. The charge by which these destructive effects are produced, is probably too inconsiderable to burst the vessels of the plant, or to occasion any material derangement of its organization: and, accordingly, it is not found, on minute examination of a plant thus killed by electricity, that either the internal vessels or any other parts have sustained perceptible injury.

THE ÆOLOPHON.

In shape, size, and compass, the Æolophon is the counterpart of a cabinet piano-forte, having six octaves of keys extending from FF to F; and its sounds are produced by a series of metallic springs, set in vibration by the action produced from a bellows. It has three pedals—one for filling the wind chest, and the others regulating the swell. The tone of this instrument, particularly in the middle and lower parts of its compass, is among

the most beautiful we have ever heard, and much superior, both in body and quality, to that of any chamber organ of equal size; added to which the Æolophon has the inestimable advantage of never varying its pitch, or getting out of tune.

From the nature of this instrument, it will be readily conceived that its best effects are displayed in slow movements, and the sustaining and swelling long notes; but, to our surprise as well as pleasure, we found that a running passage, even of semitones, could be expected upon it, if not with all the distinctness of a Drouet or a Nicholson, with as much clearness as on any organ. As an accompaniment to the piano-forte, it would be found an admirable substitute for the flute, clarinet, oboe, bassoon, or even violincello; but perhaps its widest range of usefulness will be discovered in small orchestras, where the set of wind instruments is incomplete—the effects of any, or even all of which, may be supplied by one or two performers on the Æolophon reading from the scare, or even from separate parts.

WONDEROUS EFFECTS OF CHEMISTRY.

Not to mention the impulse which its progress has given to a host of other sciences, what strange and unexpected results has it not brought to light in its application to some of the most common objects! Who, for instance, would have conceived that linen rags were capable of producing more than their own weight of sugar, by the simple agency of one of the cheapest and most abundant acids?—that dry bones could be a magazine of nutriment, capa-

ble of preservation for years, and ready to yield up their sustenance in the form best adapted to the support of life, on the application of that powerful agent, steam, which enters so largely into all our processes, or of an acid at once cheap and durable? —that sawdust itself is susceptible of conversion into a substance bearing no remote analogy to bread; and though certainly less palatable than that of flour, yet no way disagreeable, and both wholesome and digestible as well as highly nutritive.

HUMAN TIME-PIECE.

J. D. Chevalley, a native of Switzerland, has arrived at an astonishing degree of perfection in reckoning time by an internal movement. In his youth he was accustomed to pay great attention to the ringing of bells, and vibration of pendulums, and by degrees he acquired the power of continuing a succession of intervals exactly equal to those which the vibration of sounds produced.—Being on board a vessel, on the Lake of Geneva, he engaged to indicate to the crowd around him the lapse of a quarter of an hour, or as many minutes and seconds as any one chose to name, and this during a conversation the most diversified with those standing by; and farther, to indicate by the voice the moment when the hand passed over the quarter minutes, or half minutes, or any other sub-division previously stipulated, during the whole course of the experiment. This he did without mistake, notwithstanding the exertions of those about him to distract his attention, and clapped his hands at the conclusion of the time fixed. His own account of it is thus

given :—"I have acquired, by imitation, labour, and patience, a movement which neither thoughts, nor labour, nor any thing can stop : it is similar to that of a pendulum, which, at each motion of its going and returning, gives me the space of three seconds, so that twenty of them make a minute—and these I add to others continually."

TO RESTORE TAINTED GAME, OR ANY OTHER MEAT, SO AS TO BE FIT FOR USE.

Prepare it for cooking, then wrap the game in a fine linen cloth closely sewed in every part, so as to prevent any dust or cinders getting in : when this is done, take a fire-shovel full of hot charcoal or live coal, and throw into a bucket of cold water, and dip the game into it, and allow it to remain five minutes; and, upon taking it out, all the offensive smell will be removed, and it will be perfectly fit for use, but it must be dressed immediately.

RECIPE FOR BURNS.

For a burn by vitriol or by any similar cause, apply the white of eggs, mixed with powdered chalk, and lay it over the burnt parts with a feather, and it will afford immediate relief. This has been tried most successfully on a child who had accidentally taken some vitriol into his mouth.

RECIPE FOR THE STING OF A WASP, BEE, OR OTHER INSECT.

Wet the part stung, and rub a piece of indigo upon it, which will instantly remove the pain.

TO MAKE COFFEE.

There are various recipes for preparing and refining coffee; the following is the best that has ever come under our view, and is available in all places. Procure your coffee fresh roasted and not too brown, in the proportion of a quarter of a pound for three persons. Let it be Mocha, and grind it just before using. Put it in a basin, and break into it an egg yolk, white, shell and all. Mix it with a spoon to the consistence of mortar, place it with warm—not boiling—water in the coffee-pot, let it boil up and break three times, then stand a few minutes, and it will be as clear as amber, and the egg will give it a rich taste.

USE OF SALT TO PREVENT STAINS.

If red wine, fruit, jams, &c. &c., be spilt on a table-cloth, the anti-economical mode of removing them is either to apply bleaching liquor at home; or if we are too idle, or too much occupied, or too careless about the matter, we give general directions to our laundress, and she either extracts the stains or not, "as it may happen;" and too often, if the former, it is done with so little caution, that the liquid is spilled where it is not required, and not

being noticed, cannot be washed out, and the consequence is, that beautiful table linen is frequently found with holes that are perfectly unaccountable to the owner of them: and blame attaches, in consequence, to every one, from the bleacher to the shopkeeper, when she alone is in fault. Bleaching liquid is very seldom required to be used in a family if due attention be paid to a stain. The moment it is made, let salt (common table-salt) be rubbed on the spot before it have time to dry. The use of the salt is to keep it damp till the cloth is taken to the wash, when, without any further trouble or attention, it will entirely disappear by the usual process of washing. If the stain have had time to dry, the application of salt will too often fail in the effect intended; and then the use of bleaching liquor will probably be required. This, if cautiously rinsed out from the linen, will not injure cotton or linen goods.

ECONOMISING OF STEAM POWER.

Of late years, considerable efforts have been made by practical engineers to economise the powers exerted by steam engines. The attempts at improvement have only in a small degree been directed to the make or form of engines, for that appears to have reached almost as high a degree of perfection as is consistent with our existing knowledge: the main object has been to economise heat, or to produce a greater evolution and expansive force of steam, without increasing the consumption of fuel. This is an age of saving; and what is more necessary to save than the expensive material, coal, the

grand agent of heat to the steam engine? Of such consequence is it to economise fuel, that in some districts every thing may be said to depend on it: and the nearer we can bring the expense of steam to water power, so much more scope is there given for planting manufactories in situations where water power is deficient.

Various plans have been adopted for saving heat. One consists in constructing the boiler, with its furnace and flues, of such a form as will extract and use up the largest quantity of the heat evolved. The boiler best suited for receiving heat before passing off, is that which is of a long and round shape, and against not only the lower but the side parts of which the fire has room to act. The exact form, however, is well known to engine makers. Fully as necessary a requisite is the regulation of the admission of air to the fire; and, as far as we can judge, the intensity of heat is increased, without additional expense, by allowing waste steam to be injected into the furnace, either above or below the bars, thus furnishing a supply of oxygen in an easy and effective form. Another point requiring attention is to surround the whole of the exterior part of the boiler, or the building in which it is encased, with non-conducting substances. No part of any boiler should ever be open to the air, though below a roof. All parts should be well covered. In the case of high-pressure steam-engines, the disengaged or waste steam is usually blown away into the atmosphere, which is a voluntary loss of heat.

If not required for any other purpose, such as heating a house, the waste steam should be con-

densed by blowing it into a water cistern, and so raising the temperature of the water before being pumped into the boiler. It would be easy in this way to rise the temperature of the cold water to a boiling pitch, but that is not desirable, for a pump will not work in water above a certain temperature; if the water be heated beyond this, the action of the sucker draws a vapour from the fluid, instead of causing the required vacuum, and, consequently the pump labours at its work, which labour is a decided loss of power to the engine.

If the water in the cistern be raised to eighty or ninety degrees, there will be a gain of from twenty to thirty degrees of heat, and there will be a corresponding saving of fuel. The heating of the water, by the agency or waste steam in an enveloping pipe, on its passage from the pump to the boiler, is a still more effectual means, when properly managed, of elevating the temperature; the water may in this way be raised to 180 degrees before it be injected: of course, if steam, not waste, is employed in this process, the gain is met by a corresponding loss.

These, at best, are but superficial observations on the economising of heat in reference to steam, and we wish we could point to any definite and well-considered rules on the subject. A series of experiments was lately made by Dr Andrew Fyfe on the evaporative power of different kinds of coal, a notice of which appears in the Edinburgh New Philosophical Journal for April; but not being sufficiently practical, the experiments tend to scarcely any useful purpose. He observes—"Numerous methods have been recommended for securing the

perfect combustion of all the gaseous matter, such as the cautious introduction of the fuel near the front of the furnace, instead of throwing it carelessly over the whole heap in a state of combustion, by which the gradual discharge of the volatile matter is occasioned, and which, being thus expelled and passed over the ignited fuel, should be burned, provided air in sufficient quantity is present. Many others have also been proposed, such as that patented by Mr Williams of Liverpool, which consists in allowing air to flow by small streams into the furnace behind the bridge, by which the volatile matter that has escaped combustion is to be consumed. Another is that lately introduced by Mr Ivison of this place. It consists in throwing in small jets of steam at the front, of the furnace, immediately over the surface of the fuel, at the same time admitting air, at the furnace-door or otherwise, also over the fuel. Keeping out of view these and other contrivances of a similar nature, it is evident that the power of anthracite [coal] is far beyond that of other kinds of fuel, more particularly when it is of good quality, that is, rich in fixed carbon, simply because there being little, indeed in some kinds of it we may say no volatile inflammable matter, the whole of the combustible substance is consumed, and the only loss of heat, arises from that which must pass up the chimney, and by which a draft is secured, besides what is given off in the flues and otherwise by communication, through the materials of the furnace." *From Chamber's Edinburgh Journal.*

IMPROVEMENT IN THE MANUFACTURE OF PAPER HANGINGS.

In the extensive paper-works of Messrs. J. Evans and Co., at Alder Mills, near Tamworth, there is an ingenious and very beautiful piece of mechanism, the invention of the Messrs. Evans, for the printing of paper-hangings, which cannot fail to produce a complete change in this department of our manufactures, from its superiority over the ordinary method of block printing. The Messrs. Evans would have brought their invention into practical operation many years ago, had it not been for the heavy duties imposed on the manufacture of stained papers, which, by limiting the consumption, rendered their invention comparatively useless; a fact which supplies another argument against the imposition of heavy duties upon the manufacturing skill and industry of the country. In connection with the present invention, we may here state that the Messrs. Evans took out a patent in February last for an important improvement in the manufacture of paper, by the application of a pneumatic pump in the compression of the moisture from the pulp, by which means the substance is almost instantaneously converted in to paper. By this invention they are, we understand, enabled to manufacture a continuous sheet of paper six feet in width, and nearly two thousand yards in length, every hour. This paper, as it is taken off the reed, is in every respect fit for immediate use, and is conveyed on rollers to another part of the mill, in which the printing machinery is erected, through which it is passed with

great rapidity, and receives the impression of the pattern intended to be produced, with all the precision and beauty of finish which machinery alone can effect.

In order to connect the operations of the paper-making and printing machines, the Messrs. Evans have enlarged their premises, and are consequently enabled to print, glaze, and emboss, the most complicated and delicate patterns in paper-hangings, in every variety of shade or colour, as rapidly as the paper can be manufactured. Some idea may be formed of the power of the machinery, and the importance of the invention, when we state, that the machinery is capable of working at a rate which will produce sixteen hundred and eighty yards per hour, consisting of two very beautiful patterns, the only hand labour necessary being that of one man to superintend the machinery, and four girls to roll up the paper in pieces of the required length.

The whole process of manufacturing the paper from the pulp, and impressing it with the complicated patterns, is carried on within a comparatively small space, and with a precision and rapidity which affords another instance of the progress and triumph of science and mechanical skill in supplying the necessaries and comforts of civilised life.—*Chambers Edinburgh Journal.*

DOUBLE STARS.

There are certain stars, which, though appearing single to the naked eye, are found to be double on examination with a telescope. The first idea with respect to these was, that their proximity was

apparent only, arising from their being both so placed as to present themselves nearly in one line to the eye, while the smaller was really at a vast distance behind the larger. The enquiries of Sir William Herschel showed that this notion was erroneous, and that the most of the double stars are systems, in which the lesser revolves round the larger, as a planet moves round the sun, or that the two stars revolve round a common centre of gravity, serving as suns to each other.

That eminent astronomer made a catalogue of 500, which has since been greatly increased. M. Struve, a continental astronomer, has given a list of 3057, which he ascertained by an examination of 120,000 stars. It hence appears that about one star in forty may be considered double; but the proportion is greatest in the larger ones. Among 2374 stars from the first to the sixth magnitude in one region of the heavens, Struve found 230 double ones, or about one in ten. As the two stars generally differ much in brightness, the presumption is, that the double stars appear more numerous in those of higher magnitudes, only because the distance of the others is too great to permit the secondary or smaller star to be seen. When the southern hemisphere is fully explored, it is anticipated that the number of double stars will be found to amount to 5000 or 6000. There are also triple stars, of which fifty-two have been noted.

The two stars usually exhibit different intensities of light, and different colours. The larger or brighter is generally white, yellow, or red; the smaller is in a few cases green, but most commonly blue. The blue tint is believed to be generally

what is called an "accidental colour:" in other words, it is analogous to the blue shade which a feeble white light shade assumes when brought near a strong red one. There are cases, however, where the colour cannot be explained by contrast; and it is believed that blue is the real colour of some of these stars.

It is remarkable, that, of sixty or eighty thousand stars, whose positions are assigned in catalogues, the colours are all classed as white, red, or yellow; and that blue stars are only found in those binary groups which have but lately excited attention. The ancient writers speak only of white and red stars; and it is curious that Sirius, which is now white, is ranged by them among the red stars. An extremely brilliant star, which appeared in 1752, was first perfectly white, then yellow, next red, lastly, a "livid white," like Saturn, which tint continued till it disappeared. As it was only observed with the naked eye, it is possible that it may have ultimately assumed the blue tint, though the means of detecting its existence in this state were then wanting.

It has been supposed that the blue and green stars may be suns which are in the process of waning: or that these shades may indicate combustion proceeding with different degrees of intensity; or that the blue or green colour may be developed by the action of the light of the more brilliant star on an atmosphere in the smaller possessing an absorbent power.

By taking the angles of position with a telescope, the periods of revolution can be discovered. There are eight binary groups in which the element

has been determined. The shortest is 43 years, the next 58, and the next 88, and the others vary from 253 to 1200 years. The eccentricity which in the larger planets of our system is less than one-tenth, is found to vary from above five-tenths to eight-tenths, in several of those groups where it has been ascertained: so that, while the orbits of our planets approach the circles, those of the double stars are ellipses very greatly elongated. Very little is yet known of the triple stars; but in Zeta of the Crab, the two inferior stars are found to revolve round the principal one: and in Psi of Casiopeia, which consists of one brilliant star and two smaller ones, it is conjectured that the latter revolve round each other, and at the same time round their more brilliant companion—a combination of motions similar to what takes place between the earth and the moon, and the sun. The phenomena of these double and triple stars assures us of what was only matter of conjecture before, that the same law of attraction operating in the inverse ratio of the squares of the distances, which governs the motions of our solar system, extends to the utmost boundaries of the visible universe.

The study of the double stars has brought us to the verge of new discoveries of surpassing interest and grandeur. We know at present the extent and boundaries of the solar system; we know, at the same time, that it is but a minute speck in the visible creation; but science has hitherto failed us in our attempts to connect, by appreciable measurements, our sun with those millions of kindred bodies which are spread around us in the depths of celestial space.

M. Arago shows that the double stars, when carefully observed for a greater length of time, will afford us data to determine, first, their distance from the earth; and, secondly, what is still more wonderful, their masses. We shall be able, in fact, to weigh these distant bodies, as we have already weighed the planets of our system. "The day in which the distance of a double star shall be determined, will be the day on which it may be weighed, in which we shall know how many millions of times it contains more matter than the globe. We shall thus penetrate into its internal constitution, though it may be removed from us more than 120,000,000,000,000 of leagues!" There are two methods by which this knowledge can be obtained. The first is, the method of parallaxes, depending on the space the observer is carried through in the annual motion of the earth round the sun. By a telescope with a necrometer, a change even so small as the tenth of a second may be measured in the distance of two independent stars, whose apparent places are within two or three minutes of one another. Now, if the one is really at a great distance behind the other, as must be the case in some instances, the annual change of the observer's position will produce an appreciable difference in the space which separates the stars; and data may be procured in this manner, when attempts to measure absolute change of angular elevation in any particular star, give no certain results from being confounded with errors caused by variation in the instrument.

The other method, which is novel in conception, and highly curious, depends on the progressive mo-

tion of light. If the orbit of a revolving or satellite star presents near its edge to the observer's eye, it is evident that during one half of its revolution it is constantly receding from the observer, and during the other half constantly approaching him. Supposing its light to take thirty days in travelling to the earth from the nearest point to its orbit, it will require more than thirty days to reach the earth from the farthest point. Hence it will appear to spend more time in one half of its orbit than the other: and the difference betwixt the calculated and the apparent time of its transit through the nearest and farthest points of its orbit, supplies the astronomer with the data he requires. The two observed semi-revolutions differ from each other by the double of the time which the light takes to pass across the star's orbit. Hence half the difference of time expressed in seconds, and multiplied by 200,000, the number of miles which light travels in a second, will give the diameter of the orbit. This element known, the distance from the earth is easily found.

Thus a new feature in the mechanism of the heavens is unfolding itself. It was conjectured that the stars were suns; and the conjecture is not only confirmed, but we already know the periodic times of some of the bodies which revolve round them. But as our solar system includes eleven planets, not one of which would be visible from the nearest star with such telescopes as ours we may infer with safety, that only a very few of the largest of those revolving stars are or can be known to us with our present instruments, while numberless bodies, like planets, are performing their course un-

seen by us, many of them doubtless accompanied by satellites or moons, which we can have still less hope of bringing within the sphere of our vision. Every advance astronomy makes, discloses new views of the immensity and grandeur of the universe, and sinks into greater insignificance this little globe of ours, which, in the eye of the uninstructed man, is the only large and stable body in the creation. Nothing shows man so "noble in reason, so infinite in faculties," as astronomy.—*Chambers' Edinburgh Journal.*

CEMENTS.

CEMENTS require to be of very various compositions, and different with respect to the nature of the ingredients, according to the manner in which they are to be applied; and the substances they are to conjoin. The kinds of cement used for common purposes pass under the denomination of glues, sizes, pastes, and lutes: but some, that are used for extraordinary occasions, retain only the general name of cements.

COMMON GLUE.

Common glue is formed by extracting the gelatinous part of cuttings or scraps of coarse leather, or the hides of beasts, by means of long boiling with water; but this being carried on as a gross

manufacture by those who make it their proper business, the giving a more particular account of the method practised would be deviating from the proper design of this work.

ISINGLASS GLUE.

Isinglass glue is made by dissolving beaten isinglass in water; and, having strained it through a coarse linen cloth, evaporating it again to such a consistence, that being cold the glue will be perfectly hard and dry.

A great improvement may be made in this glue by adding spirit of wine or brandy to it after it is strained, and then renewing the evaporation till it gains the due consistence. Some soak the isinglass in the spirit or brandy for some time before it is dissolved, in order to make the glue; and add no water, but let the spirit supply the place of it.

This isinglass glue is far preferable to common glue for nicer purposes; being much stronger, and not so liable to be softened either by heat or moisture.

STRONG COMPOUND GLUE.

Take common glue in very small or thin bits, and isinglass glue; and infuse them in as much spirit of wine as will cover them for at least twenty-four hours. Then melt the whole together, and while they are over the fire, add as much powdered chalk as will render them an opake white.

GLUE THAT WILL RESIST MOISTURE.

Dissolve gum sanderac, and mastic, of each two ounces, in a pint of spirit of wine; adding about an ounce of clear turpentine. Then take equal parts of isinglass, and parchment glue, (formed by treating parchment in the manner above directed, for the isinglass only allowing six quarts of water to a pound of the parchment; and giving a proportionable time for the boiling;) and, having beaten the isinglass into small bits, as for common uses, and reduced the glue to the same state, pour the solution of the gums upon them; and melt the whole in a vessel well covered; avoiding so great a heat as that of boiling water. When melted, strain the glue through a coarse linen cloth: and then putting it again over the fire, add about an ounce of powdered glass.

This preparation may be best managed in balneo mariæ, which will prevent the matter burning to the vessel; or the spirit of wine from taking fire; and indeed it is better to use the same method for all the nicer glues and sizes; but, in that case, less water than the proportion directed, should be added to the materials.

A very strong glue, that will resist water, may also be made by adding half a pound of common glue or isinglass to two quarts of skimmed milk, and then evaporating the mixture to the due consistence of the glue.

GLUE FOR CEMENTING PAPER, SILK, &c.

Take of isinglass and parchment glue, each one ounce, of sugar-candy and gum tragacanth, each two drachms. Add to them one ounce of water, and boil the whole together, till the mixture appear, when cold, of the proper consistence of glue. Then form it into small rolls, or any other figure, that may be most convenient.

This glue being wet with the tongue, and rubbed on the edges of the paper, silk, &c., that are to be cemented, will, on their being laid together, and suffered to dry, unite them as firmly as any other part of the substance.

SIZES.

Common size is manufactured in the same manner, and generally by the same people, as glue. It is indeed glue left in a moister state by discontinuing the evaporation before it is brought to a dry consistence: and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared, in the manner above directed for the glue, by increasing the proportion of the water for dissolving it: and the same holds good of parchment size; and a better sort of the common size, which may be made by substituting cuttings of glover's leather instead of the parchment.

PASTES.

Paste for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence.

It may be prepared of these ingredients simply for common purposes: but when it is used by bookbinders, or for paper-hangings to rooms, it is usual to mix a fourth, fifth, or sixth of the weight of the flour, of powdered resin; and where it is required still more tenacious, gum arabic, or any kind of size may be added.

In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixed with it: but the most effectual and easy remedy is to dissolve a little sublimate, in the proportion of a drachm to a quart, in the water used for making the paste; which will prevent, not only rats and mice, but any other kind of vermin and insects from preying on the paste.

LUTES.

Lutes are cements employed for making good the joints of glasses put together, or other such like purposes, in chemical operations. In a general view the preparation of them properly belongs to the art of chemistry only; but as they are nevertheless sometimes used in other arts, it may be ex-

pedient to shew here the manner of compounding them.

In the making good junctures, where the heat is not sufficient to burn paper or vegetable substances, a mixture of linseed meal or wheaten flour and whiting, in the proportion of one part of the first to two of the last, tempered with a solution of gum senegal or arabic in water, and spread upon the joint, a narrow piece smeared with the same being put over it and pressed close, will be found effectual; or a piece of bladder smeared with gum water, or the glair of eggs, and fitted to the glasses over the joint, will answer the same purpose; but in the rectification of spirit of wine, or other such volatile substances, where the waste made by the escape of the vapour may be material, a stronger lute formed of quicksilver, tempered to a proper consistence with drying oil, should be used. This mixture should be made at the time it is wanted, as it very soon becomes dry and untractable; and great care must be taken where it is employed, to manage the heat in such a manner, that the vapour may not rise so fast as to heat the vessels beyond the due point; for this lute renders the glasses joined together by it as one entire body; and will resist the expansive force of the vapour to so great a degree, that the glasses will frequently burst before it will give way.

Where lute is to be used in places liable to be so heated as to burn vegetable or animal substances, it should be compounded of two parts of green vitriol calcined to redness, and one part of the scoria or clinkers of a smith's forge well levigated, with as much Windsor loam or Stourbridge clay dried and

powdered, tempered to a proper consistence with the blood of any beast; some short hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them.

In cases of light importance, a composition of sand, clay, and dung of horses tempered with water, may be used.

CEMENT FOR JOINING BROKEN GLASSES, CHINA, &c.

The cement, which has been most approved for uniting glass, china, or earthen ware, as also the parts of metalline bodies (where soldering is not expedient) is thus prepared.

Take two ounces of good glue, and steep it for a night in distilled vinegar; boil them together the next day; and having beaten a clove of garlic with half an ounce of ox-gall into a soft pulp, strain the juice through a linen cloth, using pressure, and add it to the glue and vinegar. Take then of sanderac powdered, and turpentine, each one drachm, and of sarcocol, and mastic, powdered, each half a drachm; and put them into a bottle with an ounce of highly rectified spirit of wine. Stop the bottle: and let the mixture stand for three hours in a gentle heat; frequently shaking it. Mix this tincture also with the glue while hot: and stir them well together with a stick or tobacco-pipe, till part of the moisture be evaporated: and then take the composition from the fire; and it will be fit for use.

When this cement is to be applied, it must be dipt in vinegar; and then melted in a proper vessel,

with a gentle heat; and when stones are to be cemented, it is proper to mix with it a little powdered tripoli or chalk; or, when glass is to be conjoined, powdered glass should be substituted.

I see no reason why common vinegar should not be equally proper for this purpose with the distilled, nor indeed am I very certain that vinegar improves in the least the cementing property of the composition.

For uniting the parts of broken china or earthenware vessels, as also the glass where the rendering the joint visible is not of consequence, the following composition, which is more easily prepared, may be substituted for the foregoing.

Take an ounce of Suffolk cheese, or any other kind devoid of fat, grate it as small as possible; and put it, with an equal weight of quick lime, into three ounces of skimmed milk.

Mix them thoroughly together; and use the composition immediately.

Where the broken vessels are for service only, and their appearance is not to be regarded, the joints may be made equally strong with any other part of the glass, by putting a slip of thin paper, or linen, smeared with this cement over them, after they are well joined together by it. This method will make a great saving in the case of glasses employed for chemical, or other similar operations.

Drying oil with white lead is also frequently used for cementing china, and earthen ware; but where it is not necessary the vessels should endure heat or moisture, isinglass glue with a little tripoli or chalk is better.

CEMENT FOR JOINING MARBLE, ALABASTER, &c.

Take of bees-wax two pounds, and of resin one pound. Melt them; and add one pound and a half of the same kind of matter powdered, as the body to be cemented is composed of; strewing into the melted mixture, and stirring them well together: and afterwards kneading the mass in water, that the powder may be thoroughly incorporated with the wax and resin. The proportion of the powdered matter may be varied, where required, in order to bring the cement nearer to the colour of the body on which it is to be employed.

This cement must be heated when applied; as must also the parts of the subject to be cemented together; and care must be taken likewise, that they be thoroughly dry.

It appears to me, that the proportion of the bees-wax is greater than it ought to be; but I receive this recipe from too good an authority to presume to alter it. When this composition is properly managed, it forms an extremely strong cement, which will even suspend a projecting body of considerable weight, after it is thoroughly dry and set; and is therefore of great use to all carvers in stone, or thers who may have occasion to join together the o rts of bodies of this nature.

CEMENTS FOR ROCK-WORK, RESERVOIRS, AND OTHER SUCH PURPOSES.

A variety of compositions are used as cements for purposes of this kind; in the application of which, regard should be had to the situation where they are employed with respect to moisture, and dryness; as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fissures that are to be made good.

Where a great quantity of cement is wanted for coarser uses, the coal-ash mortar (or Welsh tarras as it is called) is the cheapest and best; and will hold extremely well, not only where is constantly kept wet, or dry; but even where it it is sometimes dry at others wet: but where it is liable to be exposed to wet and frost, it should, at its being laid on, be suffered to dry thoroughly before any moisture have access to it; and, in that case, it will also be an improvement to temper it with the blood of any beast.

This mortar or Welsh tarras must be formed of one part lime and two parts of well-sifted coal-ashes; and they must be thoroughly mixed by being beaten together: for, on the perfect commixture of the ingredients, the goodness of the composition depends.

Where the cement is to remain continually under water, the true tarras is commonly used; and will very well answer the purpose. It may be formed of two parts of lime, and one part of plaister of

Paris; which should be thoroughly well beaten together; and then used immediately.

For the fixing shells, and other such nice purposes, putty is most generally used; but it may be formed of quicklime, and dry oil, mixed with an equal quantity of linseed oil; or, where the drying quicker is not necessary, it may be made with lime and crude linseed oil, without the drying oil.

The stone cement, prepared as above of the bees-wax and resin, is also an extremely good composition for this purpose; but resin, pitch and brick-dust, in equal parts, melted together and used hot, are much the cheapest cement for shell-work; and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are used.

SEALING-WAX.

SEALING-WAX IN GENERAL.

Sealing-wax is a cement formed of the resins, gum resins, or bodies of a similar nature, tinged with some pigment to give the colour desired: which cement ought to be capable of resisting moisture, and of being melted or growing soft by a gentle heat, and becoming hard and tenacious on its again growing cold.

Most of the resinous bodies, as seed and shell-lac, mastic, sandarac, gum gutta, gamboge, resin, turpentine, and bees-wax, have been applied to this purpose, and even sulphur (though improperly, from its disagreeable fumes on burning) has been added.

There are two kinds of sealing-wax in use, the one hard, intended for sealing letters, and other such purposes, where only a thin body can be allowed:—the other soft, designed for receiving the impressions of seals of office to charters, patents, and other such instruments of writing.

As there is with respect to the hard sort of wax a better and more common kind in use, I will give one good recipe for each sort: but shall omit all those ingredients, which, though formerly used, produce no effect but what will be equally found in these simpler and cheaper compositions.

THE BEST HARD RED SEALING-WAX.

Take of shell-lac, well powdered, two parts, of resin, and vermilion powdered also, each one part. Mix them well together; and melt them over a gentle fire; and when the ingredients seem thoroughly incorporated, work the wax into sticks. Where shell-lac cannot be procured, seed-lac may be substituted for it.

The quantity of vermilion, which is much the dearest ingredient, may be diminished without any injury to the sealing-wax, where it is not required to be of the highest and brightest red colour; and the resin should be of the whitest kind, as that improves the effect of the vermilion.

Care should be taken not to use too strong a fire in melting the ingredients; and to remove them out of the heat, as soon as they be well commixed; for, if any evaporation of the more volatile parts of the shell or red lac, or resin, be suffered, the wax is rendered proportionably brittle.

A COARSER HARD RED SEALING-WAX.

Take of resin two parts, and of shell-lac, vermilion, and red-lead, mixed in the proportion of one part of the vermilion to two of the red lead, each one part; and treat them according to the directions for the foregoing composition.

For a yet cheaper kind, the vermilion may be wholly omitted; and in the case of very coarse uses, the shell-lac also.

THE BEST HARD BLACK SEALING-WAX.

Proceed as for the best hard red sealing-wax; only instead of the vermilion substitute the best ivory black.

A COARSER HARD BLACK SEALING-WAX.

Proceed as in the composition for the coarser hard red wax; only, instead of the vermilion and red lead, substitute the common ivory black.

HARD GREEN SEALING-WAX.

Proceed as in the above: only, instead of vermilion, use verdigris, powdered; or, where the co-

lour is required to be bright, distilled or chrystals of verdigris.

HARD BLUE SEALING-WAX.

As the above; only charging the vermilion for smalt well powdered; or, for a light blue, verditer may be used: as may also a mixture of both.

YELLOW HARD SEALING-WAX.

As the above; only substituting masticot; or, where a bright colour is desired, turpeth mineral, instead of the vermilion.

HARD PURPLE SEALING-WAX.

As the red: only changing half the quantity of the vermilion for an equal or greater proportion of smalt, according as the purple is desired to be bluer or redder.

UNCOLOURED SOFT SEALING-WAX.

Take of bees wax one pound, of turpentine three ounces, and of olive oil one ounce. Place them in a proper vessel over the fire, and let them boil for some time; and the wax will then be fit to be formed into rolls or cakes for use.

COMPOSITION OF RED, BLACK, GREEN, BLUE, YELLOW, AND PURPLE SOFT SEALING-WAX.

Add to the preceding composition, while boiling, an ounce or more of any ingredient directed above for colouring the hard sealing-wax; and stir the matter well about, till the colour be thoroughly mixed with the wax.

The proportion of the colouring ingredients may be increased, if the colour produced by that here given, be not found strong enough.

THE MANNER OF FORMING SEALING-WAX INTO STICKS, BALLS, ROLLS, OR CAKES; AND PERFUMING IT.

The hard sealing-wax is generally formed into sticks, as the most expedient figure for sealing letters; but for particular purposes it is sometimes also made up in balls. The soft wax is promiscuously wrought into rolls, or cakes; as either are equally suitable to the uses it is applied to.

In order to the forming hard sealing-wax into sticks, a copper plate, or stone, big enough to allow of its being rolled out to a due length, with a rolling-board lined with a copper or block tin having a proper handle, is wanting; as likewise a small portable earthen furnace or stove for burning charcoal. The copper-plate, or stone, must have a very smooth surface; and may be in dimensions, from two to three feet long, and about two feet broad: and it must be so fixed, as to admit of its being kept of

a moderate heat while it is used. The rolling-board may be about a foot long, and about eight or ten inches in breadth; and the lining of block tin or copper, ought to be polished.

The furnace or stove for the charcoal used for this purpose, is made in the shape of a water pail with bars near the bottom for supporting the coal, and notches at the top of the sides for putting the wax over the fire; but it is needless to be more particular with regard to the construction of these furnaces or stoves; because they are to be had ready made at the earthern-ware shops.

The manner of using these several implements for forming the wax into sticks, is thus:—Take a proper quantity of the wax out of the vessel in which it is prepared, as soon as the ingredients appear duly commixed; and put it on the plate or stone; where having drawn it out into a longish figure, it must be rolled with the board upon the plate or stone, till it be of the thickness of which the sticks are required. It must then be cut into proper lengths or sticks: and it will be fit to receive the first polish.

The first polish is performed by putting one of the sticks through the notches in the furnace or stove, over a fire of charcoal, which must be previously made in it; where it must be continued and turned about, till the wax be so melted on the surface, that it become fluid as water, and run to a perfectly smooth and shining surface: when being taken out of the heat, and suffered to cool till it can be handled without affecting the polish, the other end must be put over the fire, and turned

about in the same manner till the whole be equally well polished.

The difficulty of this operation lies in adjusting properly the heat of the plate or stone on which the wax is rolled, so as to keep it of a due consistence without softening or melting it to such a degree as to make it run, or adhere to the plate or rolling board; as also in regulating properly the fire in the furnace or stove for giving the fire-polish. It is so difficult to fix a standard for degrees of heat in these cases, that no positive rules can be laid down in points of this nature; but the conduct must be left in a great measure to the judgment of the operator; who may, nevertheless, soon find by trial, how to accommodate these matters properly.

Hard sealing-wax may be formed into balls by putting a proper quantity on the plate or stone; and having fashioned it into a round form, rolling it with the board till it be smooth.

The soft wax is easily formed into rolls, or cakes, by pouring the melted mass of the ingredients, as soon as they are duly prepared, into cold water; and then, while they are yet so soft with the heat as to admit of it, working them with the hands into any figure desired.

Sealing-wax either hard or soft, may be scented by most of the perfuming ingredients, used for other purposes: and the quantity, choice, and proportion to each other of the respective ingredients, are entirely arbitrary and dependent on taste or fancy. I will, however, give a recipe or two, to show the manner of using each kind of ingredient; beginning with one of the most complex.

Take in proportion to a pound of the wax of

Benjamin half an ounce, of oil of rhodium one scruple, of musk ten grains, and of civet and amber grise, each five grains. Powder the Benjamin, musk, civet, and ambergrise together; and then rub the oil of rhodium among them: and when the wax is ready to be wrought into sticks, sprinkle in the mixture: and stir it well about, that it may equally diffuse among the wax.

The following is, however, a simpler composition; but will be found much more grateful to most persons; as there are many to whom the scent of musk and civit are very disagreeable.

Take of Benjamin one ounce, of oil of rhodium one scruple and a half, and of amber grise five grains. Treat them as the foregoing.

In perfuming the soft wax, the Benjamin may be omitted, as it requires a considerable heat to produce its scent to any effectual degree: but that alteration being made, either of the preceding compositions may be used; as in the case of the hard wax: and the ingredients may be added to the olive oil, before it be mixed with the bees wax and turpentine; or to the mass after it has boiled a due time; or to prevent the dissipation of the scent which heat occasions, the perfuming mixture may be worked or kneaded into the wax, by the hand: keeping it soft by holding it in a gentle warmth before the fire.

TO MAKE BLACKING.

Three ounces of ivory black; two ounces of treacle; half an ounce of vitriol; half an ounce of sweet oil; a quarter of a pint of vinegar, and three quar-

ters of a pint of water. Mix the oil, treacle, and ivory black gradually to a paste; then add the vitriol, and, by degrees, the vinegar and water. It will produce a beautiful polish.

PATENT STOP WATCH.

Mr. P. F. Goughy, late of Paris, has, in conjunction with Mr. French, of London, patented an improved stop watch, which the editor of the "Mechanic's Magazine" considers to be "one of the most ingenious and useful contributions to horological mechanism," which has been made within his recollection. It enables us, for the first time, to determine with infinitesimal exactness, by means of a common pocket watch (the improvement, of course, being applied to it,) the precise instant of time at which any particular occurrence take place: such as an eclipse or occultation of any of the heavenly bodies, the transit of a racer past the winning post; or of a railway locomotive, going at four times the speed of the swiftest racer, past any given point of its course. The bearer of the watch has but to press, with the finger, a small projecting knot at the outer case at the moment the moving object crosses his vision, and the information is obtained. On referring to the dial-plate, he sees the instant at which the event took place, indicated by a supplementary second-hand, previously concealed from view, by being placed exactly under the ordinary second-hand, and revolving with it, but now made, (by the pressure on the outer knot,) fixed and stationary, until the observation is written off, when, by another pressure of the finger, this supplementary

hand is made instantly to resume its original position, and to rotate with the other hand as before—the second wheel continuing in the meantime perfectly undisturbed. The patentee describes, in his specification, seven different methods of carrying the principle of his admirable invention into effect. The details of the first and best methods will be found, illustrated with engravings, in the "Mechanics' Magazine," No. 882.

GLASS WEAVING.

Few are aware that glass is now woven into silk, although its brittle nature would appear to render such a method of manufacturing it impossible. The fact, however, is indisputable, the new material being substituted for gold and silver thread, than either of which it is more durable, possessing besides the advantage of never tarnishing. What is technically called the warp, that is, the long-way of any loom-manufactured article, is composed of silk which forms the body and ground-work, on which the pattern in glass appears as the weft or cross work. The requisite flexibility of glass thread for manufacturing purposes is to be ascribed to its extreme fineness, as not less than 50 or 60 of the original threads (produced by steam-engine power) are required to form one thread for the loom. The process is slow, as not more than one yard can be manufactured in 12 hours. The work, however, is extremely beautiful, and comparatively cheap, inasmuch as no similar stuff, where bullion is really introduced, can be purchased for anything like the price at which this is sold: added to this, it is, as

far as the glass is concerned, imperishable. Some admirable specimens of the manufactured article were exhibited at the Polytechnic Institution, Regent Street, especially two patterns of silver on a blue and red ground, and another of gold on crimson. The jacquard-loom by which it is woven was also exhibited at the same establishment.

SMOKE PROTECTOR.

Mr Wallace has exhibited and explained to the British Association his apparatus for enabling persons to enter places on fire without danger from smoke, by means of breathing through water. A box of tin, containing the water, is placed on a man's back with tubes connected, forming a ring round the body and straps for the shoulders. A hood of Mackintosh cloth, glazed in front, is put on the head, and being attached to the side tubes, four gallons of water will enable a person to bear the densest smoke for twenty minutes. The protector resembles the diving apparatus in appearance.

NOVEL APPLICATION OF CAOUTCHOUC.

Mr Brockedon has recently detailed to the Royal Institution his "New Application of Caoutchouc." This was, to the stopping of bottles, decanters, and other bottles, by means of a mould or form of felted wool covered with India rubber. Humboldt mentions, in his researches, that the natives of South America use the material for stopping vessels. In that low latitude, the softness and elasticity of Caoutchouc always remains; but in the winter of our

imate it sets so hard, that, once placed in the bottle, and hardened there, it could not be withdrawn. This appeared to present an insuperable difficulty to the adoption of Caoutchouc in England for the same purpose; but a plug has been formed of felted wool, then covered with a thin sheet or film of rubber, the hardening of the rubber never equalling the elasticity of the wool; and thus a light, elastic, and impermeable stopper, perfectly air-tight and durable, has been obtained. Mr. Brockedon thus described the preparation of the wool:—Threads are bundled together in the form of a long rope, and then fulled until the fibres felt and consolidate to the degree of hardness required. This, for stoppers as a substitute for common corks, is left soft enough to remain cylindrical, and be pressed into the vessel. The stopper is shorter than a cork, and is placed in the bottle with much greater facility than by the present bottling process; for the stopper fitting, with slight pressure, perfectly air-tight, condenses the air in the neck of the bottle, and would spring out again, but that a small wire, with a groove in it is first placed in the mouth of the bottle; the stopper is then pressed with the finger down in its place, and the air escapes through the groove in the wire. The wire is then withdrawn, and the stopper kept in its place by the pressure of the atmosphere as well as its adhesion to the neck of the bottle. So perfectly may the air be thus withdrawn, that not a particle shall remain in the bottle, and the mass will appear like chrystal. If the liquid be effervescent, a flat disk of metal is to be wired over the top of the stopper and the bottle. For stopping decanters, the wool rope is felted hard enough to be turned in a lathe into

the conical form required; this is covered with the sheet rubber; and this stopper is, upon slight moisture, so air-tight, that the most delicate wines may be kept in perfect condition from day to day whilst a glass remains in the bottle. Some claret drinkers, who do not drink a bottle a day, will feel this to be a valuable discovery. The stoppers are manufactured by Mordan and Co. Another form of stopper is, the overlaying of flat felt with a shell of rubber, and then cutting out circular pieces, which are placed in the metal disks. These are placed upon the mouths of the bottles, (not in them,) and then wired down. Those in use have been found to answer perfectly for quiet liquors. This form does not require a corkscrew; the stoppers placed in the bottles are withdrawn with a corkscrew, which enters the wood with more ease, and holds more firmly than in a common cork. Many modes of forming the sheet rubber were described by cutting leaves or veneers from blocks of solid rubber, which had been formed by mastication in an engine, and then pressed into the form of a block. Of these veneers, 18 inches long and 9 wide, eight or nine weigh a pound, and cost five or six shillings; and Mr. Brockedon particularly recommended these for the purpose of covering pickle and preserve jars, as a substitute for the bladder usually employed—a foul and offensive matter, liable to decay, and destroy the things it was intended to preserve: the sheet of rubber, on the contrary, is pure and clean, and may, after washing in warm water, be again and again used. Other modes of obtaining sheet rubber for covering the stoppers were described, viz. by making solutions with naptha and other solvents

thin enough to cast on metal plates or on glass; and with a thicker solution, by rolling out the dissolved rubber into sheets upon cloth previously wetted; when the rubber thus rolled out had sufficiently hardened by the evaporation of the solvent, it could be stripped from the cloth, and when free from any smell left by the solvent, it could be applied to covering the stoppers. The stoppers can be sold at a price per gross less than that of the common corks. They are not in the least degree affected by or affect spirits, wine, beer, cider, and common drinks, since neither alcohol nor the vegetable acids have the slightest action upon Indian rubber, they, with slight pressure, close perfectly air-tight; and they do not fix as glass stoppers do in the decanters.

CHEMICAL CHANGE IN A FAIR LADY'S COMPLEXION.

It is well known that white oxide of bismuth, under the name of pearl white, is used as a cosmetic, by those of the fair sex who wish to become fairer. A lady thus painted was sitting in a lecture room, where chemistry being the subject, water impregnated with sulphuretted hydrogen gas (Harrogate water) was handed round for inspection. On smelling this liquid, the lady in question became suddenly black in the face! Every one was of course alarmed at this sudden chemical change; but the lecturer explaining the cause of the phenomenon, the lady received no further injury, than a salutary practical lesson to rely more on mental than personal and artificial beauty in future.

INVISIBLE INK.

Dissolve green vitriol and a little nitrous acid in common water. Write your characters with a new pen. Next infuse small Aleppo galls, slightly bruised, in water. In two or three days, pour the liquor off. By drawing a pencil dipped in this second solution over the characters written with the first, they will appear a beautiful black.

TO MAKE AN OBJECT WHICH IS TOO NEAR THE EYE TO BE DISTINCTLY PERCEIVED, TO BE SEEN IN A DISTINCT MANNER WITHOUT THE INTERPOSITION OF ANY GLASS.

Make a hole in a card with a needle, and without changing the place of the eye or the object, look at the latter through the hole; the object will then be seen distinctly, and even considerably magnified.

HOW TO PREPARE A CANDLE THAT THE STRONGEST WIND WILL NOT BLOW OUT.

Put some salt upon a linen rag, and roll it round the candle: you may then light the candle, and it will burn all away, even if you have it out all the while in a strong wind.

TO PUT ALE AND WATER IN A GLASS WITHOUT MIXING THEM.

Fill your glass half full of ale, and set it upon a table, then put a silk handkerchief over the glass, and press it down to the surface of the ale; you may then gently fill the glass with water, and draw up the handkerchief, and you will see the water upon the ale without mixing in the least.

TO DIVERSIFY THE COLOURS OF FLOWERS.

Fill a vessel of what size or shape you please, with good rich earth, which has been dried and sifted in the sun, then plant in the same a slip or branch of a plant bearing a white flower (for such only can be tinged), and use no other water to water it with, but such as is tinged with red, if you desire red flowers; with blue, if blue flowers, &c. With this coloured water, water the plant twice a day, morning and evening, and remove it into the house at night, so that it drink not of the morning dew for three weeks. You will then experience, that it will produce flowers, not altogether tinctured with that colour wherewith you watered it, but partly with the natural.

ILLUSTRATION OF THE ART OF CALICO PRINTING.—TO PRODUCE WHITE UPON A BLACK GROUND.

Boil a piece of white muslin for a few minutes in a solution of sulphate of iron, composed of one part of green sulphate of iron, and eight of water; squeeze it out and dry it. Then imprint upon it spots of any pattern you choose, with lemon juice; render it dry again, and rinse it well in water. If the stuff now be boiled with logwood chips and water, it will exhibit white spots on a black ground.

THE KALEIDOSCOPE.

The principal parts of the Kaleidoscope are two reflecting planes made of glass or metal, or any other reflecting substance, ground perfectly flat, and highly polished. These reflectors may have any magnitude, but in general they should be from four or five to ten or twelve inches long, their greatest breadth about an inch when the length is six inches, and increasing in proportion as the length increases. When these two plates are put together at an angle of 60, or the sixth part of a circle, and the eye placed at the narrow end, it will observe the opening multiplied six times, and arranged round the centre.

WINDOW GLASS.

Window glass is usually composed of only two materials, kelp and fine white sand. Pearl ashes

and other alkalis are, however, sometimes used instead of the former. Kelp, it is well known, is produced by the burning of sea weed. It is cut from the rocks for this purpose in the months of May, June, and July; and after being spread out for some time to dry, it is gathered together and thrown into a pit, where it is reduced to a state of fusion by fire. When cool, it becomes a hard solid substance, and is then broken up into small portable masses for the convenience of transportation. The kelp which it is intended to use in glass-making is broken first into very small pieces by a machine called a stamper. It is then put through a mill, ground to a fine powder, and afterwards passed through a brass wire sieve. The sand again, with which it is to be mixed, is usually washed in a large vat with either boiling or cold water, until the latter runs quite clear off. It is sometimes, also, put into an anneal or calcining arch, where it is subjected to a strong heat for twenty-four hours, and then plunged into water. When this operation is completed, the sand, of which the best for the purpose of the glass-maker is procured from Lynn Regis, in Norfolk, is mingled with the kelp powder in proportions adjusted by the experience of the mixer, but generally in the degree of one part of the former to two parts of the latter. When thoroughly mixed, the compost is put into a calcining arch, or reverberatory furnace, where it is reduced to a semi-fluid state. This substance, which is technically called frit, is then taken from the furnace, spread on a plate of iron, and, before becoming quite cool, is broken into large cakes. It is then thrown into the melting-pot, together with a proportion of what is called

cullet, which is simply broken crown glass, and in about thirty to thirty-six hours the whole is reduced by a powerful heat to a fine liquid glass, and is then ready for the operations of the workman, having been previously skimmed to remove all extraneous substances from the surface.

The melting-pot is made of the finest clay, and is subjected to a tedious and exceedingly troublesome process of annealing or tempering before it can be used for its ultimate purpose. The best clay for making these pots is got from Stourbridge, in England. When this glass is in a perfect liquid state, an iron tube of about six or seven feet in length is dipped into it, and a portion of the metal gathered on the end of it. This is afterwards blown into the shape of a large globe. By a subsequent operation, a small aperture is made in the centre of this sphere on the side opposite to that on which it is attached to the iron rod held by the workman; the latter now holding the globe before the mouth of the furnace until it has become sufficiently ductile to yield readily to any impression, twirls round it with great velocity, when the aperture already spoken of gradually widens till it reaches a certain point, when the globe which is also gradually losing its spherical form, suddenly flies open with a loud ruffling noise, and become a plane or circular sheet of glass, of about fifty inches diameter. This is an exceeding beautiful operation, and well worth seeing. After undergoing a process of tempering or annealing, the sheet is divided in two with a diamond, and in this shape it comes into the hands of the glazier.

Although there are several substances that will

cut glass, there is none that answers so well for this purpose, or that will last so long when thus employed, as the diamond. Dr. Wollaston, after much labour, succeeded in giving a sapphire, ruby, spinal ruby, rock-crystal, and several other substances, the peculiar curvilinear edge which forms the cutting point in the diamond, and was thus enabled to cut glass with them, but these substances soon lost their edge, whereas that of the diamond will endure for many years, though in constant daily use. The cutting point even of the diamond, however, must be a natural one; no artificial point will do this; neither will this point be produced by simply fracturing the mineral. The diamond of a ring, for instance, will not cut glass, but merely mark it with rough, obvious, superficial lines. The smooth, deep, effective cut necessary to divide glass, can only be produced, as already said, by a natural point. The diamond used by the glazier is called a spark, being extremely minute. It is set into a metal socket, which again is attached to a wooden handle four or five inches long. The glazier's diamond is of the description known by the technical name of bort, which includes all such pieces as are too small to be cut, or are of bad colour, and consequently unfit for ornamental purposes. These are selected from the better sort, and sold at an inferior price.

SEAMEN'S LIFE PRESERVER.

This invention of Mr. A. Symington, of Kettle, consists of a peculiarly constructed jacket or belt, which can be bound at pleasure round the waist; it

is light and flexible, and when immersed in water, its buoyancy is so powerful, that it will not only keep the head above water, but also part of the shoulders, and preserve the body afloat for a great length of time.

GEARY'S PATENT WOOD PAVING.

This patent embraces about twenty differently formed blocks for paving streets, tram-roads, and railways. The form designated "the bevil-shoulder-block" is stated to be superior to all others, and to possess all the advantages of the Whitehall and Oxford-street paving (considered to be the most successful specimens in the metropolis), without the objection of pinning. These blocks are on a self-supporting principle, each acting on a shoulder, and cross-jointed; thereby preventing the rising or sinking of any block, but allowing each to be easily taken out for repairing or laying gas or water pipes. Another great advantage of Mr. Geary's plan is the introduction of a pyramid-bearing block in every ten or twelve feet, so as to divide the pressure and form the pavement into a succession of arches across the street, instead of one continual bearing line from curb to curb.

NEW ALLOYS.—CAST STEEL.

A manufacturer, of Paris, has invented a composition much less oxidizable than silver, and which will not melt at less than a heat treble that which silver will bear; the cost being less than 4d. per ounce.

NEW PROCESS OF PRINTING IN COLOURS.

Mr Charles Hancock, the eminent animal painter, has patented a new method of painting, engraving, and printing in colours, so as to present a perfect fac-simile of the original. The means are briefly as follow. An outline is first etched and transferred to as many plates as there are positive colours in the picture; and any required gradations of light and shade in each colour are produced upon the plate assigned to that colour, by any of the ordinary modes of engraving. The different plates are then printed from in succession, with the colours appropriate to each; the chief care required being that of adjustment, so that one impression shall not, in the slightest degree, overlay another. Two or three engravers can, by this process, work simultaneously from the same picture, and a greater number of copies can be produced in a given time than has hitherto been done by any other method. The cost of each series of plates is not more than that of one plate engraved in the usual way, the metal only excepted; while against the extra expense of working must be placed the saving of the print-colourer's charge. This process, it is stated, will be found equally valuable to some of our manufactures—in the ornamenting of china, for example, paper-hangings, cottons, silks, &c.; particularly as the process can be applied to surfaces engraving in relief and printed at a type-press, as well as to the ordinary modes of copper-plate engraving and printing.

NEW METHOD OF CASTING IRON.

An Englishman at Brussels has discovered a mode of casting iron, so that it flows from the furnace pure steel, better than the best cast iron in England, and almost equal to that which has undergone the process of beating. The cost of this steel is only a farthing per lb. greater than that of cast iron.

NEW METHOD OF CUTTING WOOD.

Messrs. Taylor and Wilmot have patented an invention for cutting wood into staves for all kinds of cooperage, shingles, park-pales, &c. The block of wood to be cut is first submitted to steam for half or three quarters of an hour, and softened; which not only does not injure the fibre, but by destroying animal life and vegetable fungi, greatly improves the substance, and renders it more durable. It is then presented to the knives, either acting in a perpendicular direction and chopping right down, or set in circular iron plates, and working with immense velocity as they go round, cutting the block into the required forms in length, breadth, and thickness, with perfect accuracy. The stroke, or the circular cut (as either machine is employed), is as easy as if it was slicing butter, and there is not a particle of saw-dust, chipping, or any waste of any kind.

ADULTERATION OF BONE DUST.

It appears that saw-dust, slacked lime, and numerous other ingredients, are now mixed with bone manure; so that in some cases the admixture not only destroys the nutritive qualities of the bone-dust, but is most injurious to turnip seed. The great increase in the use of this fertiliser renders these facts important. Large quantities are now imported from abroad, in addition to the enormous mass annually collected in this country;—thus it appears that in 1823 the declared value of bone imported was £14,397; in 1837 it was £254,600, and since that period that amount has probably doubled.

PRINTING FOR THE BLIND.

The first copy of the Bible ever printed for the use of the blind has been completed by Mr. Alston, at the Blind Asylum, Glasgow. It is in 15 volumes, super-royal quarto, double pica: nine volumes of 200 copies each, and six volumes of 250 copies each; in all, 3,300 volumes. There are 2,470, pages, each page containing 37 lines; 1,160 reams of paper, weighing 8½lbs. each ream: 9,800 lbs. The paper was made on purpose, strongly sized to retain the impression. In order to account for the great size of the work, it must be borne in mind that it can only be printed on one side, in order to suit the touch. The printing is effected by a copper-plate printing press. The types being strongly relieved, and liable to give way under the heavy pressure required, it has been

necessary to have them recast no less than four times during the progress of the work. There are in the operative department, one man and one boy as compositors, who were taught in the Institution: and one pressman, the ordinary teacher acting as corrector of the press. The New Testament is completed in four volumes, super-royal quarto, in great primer. There are 623 pages, forty-two lines in each page; 450 reams of paper, the same as made for the Bible, weighing 3,825 lbs.; 250 copies. There have been published altogether by the Glasgow Asylum, 10,850 volumes printed for the blind.

THE IRISCOPE.

Dr. Reade has exhibited to the British Association the following experiment, with an instrument which he called an Iriscope. A piece of black polished glass was rubbed over in part with a solution of Castile soap; as soon as it was dry, the soap was polished off with a glove, until as far as appearances were concerned, the one part of the glass was as clean as the other. He then blew his breath on the plate through a tube about half an inch in bore, and instantly the most vivid rings of colours (resembling Nobili's) were exhibited where the breath condensed on the part of the glass which had been previously soaped; while, on the other part, the condensed breath exhibited simply the usual dead grey colour.

GAS-LIGHTING LONDON.

For lighting London and its suburbs with Gas, there are eighteen public gas-works: twelve public gas-work companies: £2,800,000 capital employed in works, pipes, tanks, gas-holders, apparatus; £450,000 yearly revenue derived; 180,000 tons of coals used in the year for making gas; 1,460,000,000 cubic feet of gas made in the year; 134,200 private burners supplied to about 400,000 customers; 30,400 public, or street, consumers; about 2,650 of these are in the city of London; 380 lamplighters employed; 176 gas-holders, several of them are double ones, capable of storing 5,500,000 cubic feet: 890 tons of coals used in the retorts, in the shortest day, in twenty-four hours; 7,120,000 cubic feet of gas used in the longest night, say 24th December; about 2,500 persons employed in the metropolis alone in this branch of manufacture: between 1822 and 1827, the consumption was nearly doubled; and, between 1827 and 1837, it was again doubled.

SPONTANEOUS HEATING OF CAST-IRON.

Cast iron, when brought into the air, after it had been for many years under salt and water, has become red hot. Thus, in June, 1836, some cannon balls were raised from the ship, Mary Rose, which sunk in the naval engagement near the Isle of Wight, in July, 1545, nearly 300 years before. These balls all became hot on exposure to the air, and fell to pieces. The cast iron gratings, after

being long immersed in the porter-vats in the large breweries of London, grow hot, when the porter is drawn off, from a similar cause.

JETS OF FIRE.

Jets of fire are a kind of fixed rockets, the effect of which is to throw up into the air jets of fire, similar to jets of water. They serve also to represent cascades; for if a series of such rockets be placed horizontally on the same line, it may be easily seen that the fire they emit will resemble a sheet of water. When arraigned in a circular form, like the radii of a circle, they form what is called a fixed sun.

To form jets of this kinds, the cartridge for brilliant fires must, in thickness, be equal to a fourth part of the diameter, and for Chinese fires, only to a sixth part.

The cartridge is loaded on a nipple, having a point equal in length to the same diameter, and in thickness to a fourth part of it; but as it generally happens that the mouth of the jet becomes larger than is necessary for the effect of the fire, you must begin to charge the cartridge, as the Chinese do, by filling it to a height equal to a fourth part of the diameter with clay, which must be rammed down as if it were gunpowder. By these means the jet will ascend much higher. When the charge is

completed with the composition you have made choice of, the cartridge must be closed with a tompion of wood, above which it must be choaked.

The train or match must be of the same composition as that employed for loading; otherwise the dilation of the air contained in the hole made by the piercer, would cause the jet to burst.

Clayed rockets may be pierced with two holes near the neck, in order to have three jets in the same place.

If a kind of top, pierced with a number of holes, be added to them, they will imitate a bubbling fountain.

Jets intended for representing sheets of fire ought not to be choaked. They must be placed in an horizontal position, or inclined a little downwards.

It appears to us that they might be choaked so as to form a kind of slit, and be pierced in the same manner; which would contribute to extend the sheet of fire still farther. A kind of long narrow mouth might even be provided for this particular purpose.

TO MAKE JETS OF FIVE LINES OR LESS, OF INTERIOR DIAMETER.

Chinese Fire.—Saltpetre one pound, pulverised gunpowder one pound, sulphur eight ounces, charcoal two ounces.

White Fire.—Saltpetre one pound, pulverised gunpowder eight ounces, sulphur three ounces, charcoal two ounces, iron sand of the first order eight ounces.

TO MAKE JETS OF FROM TEN TO TWELVE LINES IN DIAMETER.

Brilliant Fire.—Pulverised gunpowder one pound, iron filings of a mean size five ounces.

White Fire—Saltpetre one pound, pulverised gunpowder one pound, sulphur eight ounces, charcoal two ounces.

Chinese Fire.—Saltpetre one pound four ounces, sulphur five ounces, sand of the third order twelve ounces.

TO MAKE JETS OF FIFTEEN OR EIGHTEEN LINES IN DIAMETER.

Chinese Fire.—Saltpetre one pound four ounces, sulphur seven ounces, charcoal five ounces, of the six different kinds of sand mixed twelve ounces.

Pere d'Incarville, in his memoirs on this subject, gives various other proportions for the composition of these jets; but we must confine ourselves to what has been here said.

The saltpetre, pulverised gunpowder, and charcoal, are three times sifted through a hair sieve. The iron sand is besprinkled with sulphur, after being moistened with a little brandy, that the sulphur may adhere to it; and they are then mixed together: the sulphur sand is then spread over the first mixture, and the whole is mixed with the ladle only; for if a sieve were employed, it would separate the sand from the other materials. When sand larger than that of the second order is used, the

composition is moistened with brandy, so that it forms itself into balls, and the jets are then loaded: if there were too much moisture, the sand would not perform its effect.

TO MAKE FIRES OF DIFFERENT COLOURS.

It is much to be wished that, for the sake of variety, different colours could be given to the fire-works at pleasure; but though we are acquainted with several materials which communicate to flame various colours, it has hitherto been possible to introduce only a very few colours into that of inflamed gunpowder.

To make white fire, the gunpowder must be mixed with iron or rather steel filings.

To make red fire, iron sand of the first order must be employed in the same manner.

As copper filings, when thrown into a flame, render it green, it might be concluded, that if mixed with gunpowder, it would produce a green flame; but this experiment does not succeed. It is supposed that the flame is too ardent, and consumes the inflammable part of the copper too soon. But it is probable that a sufficient number of trials have not yet been made; for it is not possible to lessen the force of gunpowder in a considerable degree, by increasing the dose of the charcoal.

However, the following are a few of those materials which, in books on pyrotechny, are said to possess the property of communicating various colours to fire-works.

Camphor mixed with the composition, makes the flame to appear of a pale white colour.

Raspings of ivory, give a clear flame of a silver colour, inclining a little to that of lead: or rather a white dazzling flame.

Greek pitch produces a reddish flame, of a bronze colour.

Black pitch, a dusky flame, like a thick smoke, which obscures the atmosphere.

Sulphur, mixed with a moderate quantity, makes the flame appear bluish.

Sal ammoniac and verdigris give a greenish flame.

Raspings of yellow amber communicate to the flame a lemon colour.

Crude antimony gives a russet colour.

Borax ought to produce a blue flame; for spirit of wine, in which sedative, salt, one of the component parts of borax, is dissolved by the means of heat, burns with a beautiful green flame.

Much, however, still remains to be done in regard to this subject; but it would add to the beauty of artificial fire-works, if they could be varied by giving them different colours: this would be creating for the eyes a new pleasure.

TO MAKE GLOBES ON THE WATER.

These globes, or fire-balls, are made in three different forms: spherical, spheroidal, or cylindrical; but we shall here confine ourselves to the spherical.

To make a spherical fire ball, construct a hollow wooden globe of any size at pleasure, and very round both within and without, so that its thickness

may be equal to about the ninth part of the diameter. Insert in the upper part of it a right concave cylinder, the breadth of which may be equal to the fifth part of the diameter; and having an aperture equal to the thickness, that is, to the ninth part of the diameter. It is through this aperture that the fire is communicated to the globe, when it has been filled with the proper composition, through the lower aperture. A petard of metal, loaded with good grained powder, is to be introduced also through the lower aperture, and to be placed horizontally.

When this is done, close up the aperture, which is nearly equal to the thickness of the cylinder, by means of a wooden tompion dipped in warm pitch; and melt over it such a quantity of lead that it may cause the globe to sink in water; which will be the case if the weight of the lead, with that of the globe and the composition, be equal to the weight of an equal volume of water. If the globe be then placed in the water, the lead by its gravity will make the aperture tend directly downward, and keep in a perpendicular direction the cylinder, to which fire must have been previously applied.

To ascertain whether the lead, which has been added to the globe, renders its weight equal to that of an equal volume of water, rub the globe over with pitch or grease, and make a trial, by placing it in the water.

The composition by which the globe must be loaded, is as follows: to a pound of grained powder, add thirty-two pounds of salt-petre reduced to fine flour, eight pounds of sulphur, one ounce of scrapings of ivory, and eight pounds of saw-dust

previously boiled in a solution of salt-petre, and dried in the shade, or in the sun.

Or, to two pounds of bruised gunpowder, add twelve pounds of salt-petre, six pounds of iron filings, and one pound of Greek pitch.

It is not necessary that this composition should be beaten so fine as that intended for rockets; it requires neither to be pulverized nor sifted; it is sufficient to be well mixed and incorporated. But to prevent it from becoming too dry, it will be proper to besprinkle it with a little oil, or any other liquid susceptible of inflammation.

TO MAKE GLOBES WHICH LEAP OR ROLL ON THE GROUND.

Having constructed a wooden globe with a cylinder, similar to that above described, and having loaded it with the same composition, introduce into it four petards, or even more, loaded with good grained gunpowder to their orifices, which must be well stopped with paper or tow. If a globe be prepared in this manner, and fired by means of a match, it will leap about, as it burns, on a smooth horizontal plane, according as the petards are set on fire.

Instead of placing these petards in the insides, they must be affixed to the exterior surface of the globe; which they will make to roll and leap as they catch fire. They may be applied in any manner to the surface of the globe.

A similar globe may be made to roll about on an horizontal plane, with a very rapid motion. Con-

struct two equal hemispheres of pasteboord, and adjust in one of them three common rockets filled and pierced like flying rockets that have no petard: these rockets must not exceed the interior breadth of the hemisphere, and ought to be arranged in such a manner that the head of the one shall correspond to the tail of the other.

The rockets being thus arranged, join the two hemispheres, by cementing them together with strong paper, in such a manner that they shall not separate, while the globe is moving and turning, at the same time the rockets produce their effect. To set fire to the first, make a hole in the globe opposite to the tail of it, and introduce into it a match. This match will communicate fire to the first rocket; which, when consumed, will set fire to the second by means of another match, and so on to the rest; so that the globe, if placed on a smooth horizontal plane, will be kept in continual motion.

It is here to be observed, that a few more holes must be made in the globe, otherwise it will burst.

The two hemispheres of pasteboard may be prepared in the following manner: construct a very round globe of solid wood, and cover it with melted wax: then cement over it several bands of coarse paper, about two inches in breadth, giving it several coats of this kind, to the thickness of about two lines. Or, what will be still easier and better, having dissolved, in glue water, some of the pulp employed by the paper-makers, cover with it the surface of the globe; then dry it gradually over a slow fire, and cut it through in the middle; by which means you will have two strong hemispheres. This

wooden globe may be easily separated from the pasteboard by means of heat; for if the whole be applied to a strong fire the wax will dissolve, so that the globe may be drawn out. Instead of melted wax, soap may be employed.

TO MAKE AERIAL GLOBES, CALLED BOMBS.

These globes are called aerial, because they are thrown into the air from a mortar, which is a short thick piece of artillery of a large calibre.

Though these globes are of wood, and have a suitable thickness, namely, equal to the twelfth part of their diameters, if too much powder be put into the mortar, they will not be able to resist its force; the change of powder must therefore be proportioned to the globe to be ejected. The usual quantity is an ounce of powder for a globe of four pounds weight; two ounces for one of eight, and so on.

As the chamber of the mortar may be too large to contain the exact quantity of powder sufficient for the fire-ball, which ought to be placed immediately above the powder, in order that it may be expelled and set on fire at the same time, another mortar may be constructed of wood, or of pasteboard with a wooden bottom: it ought to be put into a large iron mortar, and to be loaded with a quantity of powder proportioned to the weight of the globe.

The small mortar must be of light wood, or of paper pasted together, and rolled up in the form of a cylinder, or truncated cone, the bottoms excepted;

which, as already said, must be of wood. The chamber for the powder must be pierced obliquely, with a small gimlet; so that the aperture corresponding to the aperture of the metal mortar, the fire applied to the latter may be communicated to the powder which is at the bottom of the chamber, immediately below the globe. By this means the globe will catch fire, and make an agreeable noise as it rises into the air; but it would not succeed so well, if any vacuity were left between the powder and the globe.

A prolific or perpendicular section of such a globe is represented by the right-angled parallelogram, the breadth of which is nearly equal to the height. The thickness of the wood, towards the two sides, is equal, as above said, to the twelfth part of the diameter of the globe; and the thickness of the cover is double the preceding, or equal to a sixth part of the diameter. The height of the chamber where the match is applied, and which is terminated by a semicircle, is equal to the fourth part of the breadth: and its breadth is equal to the sixth part.

We must observe that it is dangerous to put wooden covers on aerial balloons or globes; for these covers may be so heavy, as to wound those on whom they happen to fall. It will be sufficient to place turf or hay above the globe, in order that the powder may experience some resistance.

The globe must be filled with several pieces of cane or common reed, equal in length to the interior height of the globe, and charged with a slow composition, made of three ounces of pounded gunpowder, an ounce of sulphur, moistened with a small quantity of petroleum oil, and two ounces of char-

coal; and in order that these reeds or canes may catch fire sooner, and with more facility, they must be charged at the lower ends, which rest on the bottom of the globe, with pulverised gunpowder moistened in the same manner with petroleum oil, or well besprinkled with brandy, and then dried.

The bottom of the globe ought to be covered with a little gunpowder half pulverised and half-grained; which, when set on fire, by means of a match applied to the end of the chamber, will set fire to the lower part of the reed. But care must have been taken to fill the chamber with a composition similar to that in the reeds, or with a slow composition, made of eight ounces of sulphur, and one ounce of charcoal: the whole must be well pounded and mixed.

Instead of reeds, the globe may be charged with running rockets, or paper petards, and a quantity of fiery stars or sparks mixed with pulverised gunpowder, placed without any order above these petards which must be choaked at unequal heights, that they may performed their effects at different times.

These globes may be constructed in various ways which it would be tedious here to enumerate. We shall only observe, that when loaded, they must be well covered at the top; they must be wrapped up in a piece of cloth dipped in glue, and a piece of woollen cloth must be tied round them, so as to cover the hole which contains the match.

ON THE SUGAR-CANE.

This plant has been considered by some historians, to be originally a native of the East Indies; others have asserted that it is likewise a native of the islands and continent of America. With respect to my knowledge of it, I certainly am indebted to the West Indies. Without doubt it claims an eminent rank in the system of botany. For luxuriance, and general usefulness, it has, I think, the pre-eminence of every foreign plant: and God himself, it appears, would have condescended to receive the oblation of it, had the Israelites had generosity sufficient to have offered it in his worship; their illiberality is severely censured by the prophet Isaiah, chap. xliii. 24. "Thou has bought me no sweet cane with money:" and their hypocrisy, by Jeremiah, even when they brought this oblation, Jer. vi. 23. "To what purpose cometh there to me incense from Sheba? and the sweet cane from a far country? your burnt-offerings are not acceptable, nor your sacrifices sweet unto me."

The sugar-cane is a plant that comes to maturity in ten or twelve months, and it will produce a second and third crop from the old roots the succeeding years, without any material cultivation; but the crops are not a fourth part equal to the first. Hence, in order to procure a profitable crop, it requires to be replanted every year, and, in order to render it very productive, it is necessary that the land be deeply harrowed, and richly manured. The general height of the cane, including the top, is about ten feet, though sometimes considerably taller.

A large field of well grown sugar-canes, affords a beautiful prospect to the eye, especially if wafted to and fro with a moderate breeze; it is a striking representation of the majestic sea, when agitated to a degree of grandeur, and not boisterous. The commonly received opinion in reference to sugar, is, that the cane is hollow, and that the sugar in a matured state, is literally taken out of the inside of it. But this is a gross error. The process to produce sugar, manifests much ingenuity, and to manufacture it with considerable success, is an art that requires great and assiduous attention, and considerable experience. I have already observed, that the cane may be reckoned about ten feet high, three feet and a half, which constitutes the top, consisting of leaves, are taken off. The edges of these leaves are finely serrated, and terminate in an arrow, decorated with a fine downy brush. The top which is taken off, makes excellent fodder for horses and cattle. The parts intended for sugar, are cut down, tied in bundles, and carried in carts to the mills, where they are bruised, and the juice is extracted from them. These mills are, necessarily, very large and strong, for it requires considerable force to press the juice from the cane.

The mills consist principally of upright iron-plated rollers, or cylinders, from thirty to forty inches in length, and from twenty to twenty-five inches diameter; and the middle one, to which the moving power is applied, turns the other two by means of cogs. Between these rollers the canes are compressed, and the juice extracted. The juice, which has a sweet taste, is a little thicker than apple juice. A common cart-load, tolerably well pack-

ed, will produce about one hundred and twenty gallons of liquor. The juice, as it flows from the mill, is supposed to contain eight parts of pure water, one part of sugar, and one part consisting of coarse oil and mucilaginous gum, with a portion of essential oil. Proper cisterns are provided to receive the liquor from the mill, and from thence it is conveyed by pipes, to the boiling-house, where a large range of coppers are prepared for it. It is, first of all, conveyed to a copper of about five or six hundred gallons. It is necessary to put about a pint of Bristol quick-lime powder to every hundred gallons of liquor, to unite with the superabundant acid, which, for the success of the process, it is requisite to get rid of. After simmering in this copper for about an hour, under a slow fire, the fire is withdrawn, the liquor remaining undisturbed, till the scum naturally rises to the top, and a degree of sediment falls to the bottom; it is then drawn off, and conveyed to smaller coppers, under which a perpetual fire is kept up, and where two men are employed to take off the scum, as fast as it rises, till it be properly clarified. From thence it is conveyed to three smaller coppers, called teaches, in the last of which by boiling on the fire, it is brought to a proper consistency to be removed. It is then poured from the copper, or teache, into large shallow coolers, either made of wood or copper, about eleven or twelve inches deep. The sugar remains in these coolers a shorter or longer time, according to the kind for which it is intended. If it be intended for clayed, or white sugar, it only remains for about an hour; if for muscovado, or brown sugar, continues till the next morning, when

it is put into hogsheads, for the treacle to drain from it. If it be intended for clayed, or white sugar, it is put into earthen moulds (the form of a loaf of sugar) about an hour after it is taken off from the fire.

The brown sugar is cured and fit for exportation in eight or ten days after it is made; but the clayed sugar will take near three months before it is fit to be exported. It is worthy of notice that nothing is lost in a sugar-cane. The sugar itself is a luxury, which we are well acquainted with, and so palatable, salutary, and nourishing is the juice of the cane, that the good effects of it are soon visible in the poor negroes; many that were meagre and sickly before the sugar crop began, soon revive, and become healthy when the crop begins to be taken; and it is surprising the quantity of juice they will drink at a time, which they are not prevented from, unless their master be a complete tyrant. The cane after the juice is extracted, makes excellent fuel, for boiling the sugar, the green top of the cane fodder for horses and cattle, the dry blades, or leaves, litter for stable, the ashes made very good manure, and the scum, and all the washings of the various apparatus assist in the distillery for rum.

SPEAKING MACHINES.

The Abbe Mieal, a celebrated French mechanician, constructed two colossal brazen heads, which are said to have uttered not only words, but entire phrases; he submitted these masterpieces of his ingenuity to the Academy of Sciences, in July, 1783; but being disappointed of the reward, which, on the

recommendation of the Academy, he expected from the government, he broke them to pieces. A celebrated anatomist (Vicq d' Azyr) gives the following account of their construction:—"The heads covered a hollow box, the different parts of which were connected together by hinges, and in the interior of which the inventor had disposed artificial glottises of different forms over stretched membranes. The air passing through these glottises, was directed on these membranes, which gave sounds of different pitches; and from the combination there resulted a very imperfect imitation of the human voice." Sir David Brewster thinks that "before another century is completed, a talking and a singing machine will be numbered among the conquests of science."

ARTIFICIAL PRODUCTION OF THUNDER, LIGHTNING, AND RAIN.

An experiment is in contemplation, to be tried in America, to produce these phenomena almost at pleasure. It is well known that vapour exists in much greater abundance near the earth's surface than higher up, and that if this vapour could be elevated in ample quantities to a sufficient height, the superior cold would condense it into clouds, which, from the very process of evaporation and condensation, would become electrical; hence may proceed these grand phenomena of nature. The method obviously pointed out is, to produce a powerful current from the surface upwards, at the time the atmosphere is otherwise still, which may be accomplished by a great heat rarifying the subtrata. This is indeed the very step nature follows; and it was

lately stated to us, before gentlemen, by a distinguished philosopher, that it had actually been done, though accidentally, in America. A large quantity of wood or turf was by some means set on fire, and after burning a considerable time, a deep cloud formed above, and the phenomena of thunder, &c., followed. In corroboration of this, it has been remarked by several that heavy rain, and not unfrequently thunder and lightning, follow great battles.

INDELIBLE INK FOR MARKING LINEN.

Dissolve two drachms of fused sub-nitrate of silver in six drachms of distilled water, and add to it two drachms of thick mucilage of gum arabic (by measure); this forms the marking ink. Then dissolve half an ounce of sub-carbonate of soda in four ounces of water; add to the solution half an ounce (by measure) of thick mucilage of gum arabic.

To use the ink, wet thoroughly the part intended to be written on with the last mixture, and, when quite dry, write thereon with a clean pen dipped in the first preparation, and let it dry; the letters will be pale at first, but soon become black by exposure to the air.

TO RESTORE FADED WRITING.

Sometimes the ink of very old writing is so much faded by time as to be illegible, in consequence of the decay of the tanning matter and gallic acid contained in the ink, and a yellow or brown oxide of iron therefore alone remains on the paper. The

original colour of the written characters may be restored, or, rather, a new body of colour may be given to the writing by pencilling it over carefully, first with a solution of prussiate of potass, and then with diluted muriatic acid.

If the pencilling be done neatly, and blotting paper be laid over the letters as fast as they become visible, their form will be retained very distinctly. Pencilling over the letters with an infusion of gall nuts, or tincture of galls, also restores the blackness to a certain degree, but not so speedily nor so completely as potass.

CHEMICAL SOAP FOR REMOVING GREASE SPOTS.

Take about an ounce of fuller's-earth crumbled to powder, moisten it with a little spirits of turpentine; then take about half an ounce of salt of tartar and an ounce of the best potass, and work the whole into a paste with a little soft soap: form it into squares, and it will be fit for use. Moisten the grease, and, with a little water, rub the sauce well on till it lathers; persevere in this for a short time until the spot disappears, then rinse the cloth with clear water.

TEST TO DISTINGUISH IRON FROM STEEL.

To distinguish iron from steel by a chemical process, take nitric acid, dilute it with so much water that it will only act feebly on the blade of a common table-knife. If a drop of the acid thus diluted be dropped upon steel, and allowed to re-

main on it a few minutes, and then washed off with water, it bears a black spot; but if a drop of the same acid be put upon iron, the spot will not be black, but of a whitish grey.

TEST TO DETECT ARSENIC.

The presence of arsenic may be detected by subnitrate of silver. We are indebted to Mr. Hume for this test;—pour a few table spoonfuls of the suspected liquid into a wine glass, and present to the mere surface of the liquid a stick of dry subnitrate of silver, or lunar caustic: a yellow precipitate will instantly appear if it contains the least particle of arsenic, which will proceed from the point of contact of the subnitrate of the fluid and settle at the bottom of the glass.

Dr. Marcet has lately pointed out the following modification of the test:—Let the fluid suspected to contain arsenic be filtered, and suffer the end of a glass rod, wetted with liquid ammonia, to be brought into contact with it; and let the end of a glass rod, also wetted with the solution of nitrate of silver, be immersed in the mixture; a yellow precipitate will gradually fall to the bottom: as this precipitate is soluble in ammonia, the greatest care is necessary not to add an excess of it.

The objection arising from the action of muriatic acid upon this test is easily obviated: for, if a little muriatic acid be dipped into the fluid suspected to contain arsenic, and the nitrate of silver very cautiously be added till the precipitate ceases, the muriatic acid will be removed, and the arsenic remain in solution, and the addition of liquid ammonia

will produce the yellow precipitate in its characteristic form.

TO CLEAN OLD GOLD.

Dissolve sal-ammoniac in wine, and boil the article in it for a short time; clean it with rag and whiting.

NANKEEN DYE.

Boil equal parts of annatto and common potass in water till the whole is dissolved.

TO STAIN LEATHER GLOVES.

Those different pleasing hues of yellow, brown, or tan colour, are readily imparted to leather gloves by the following simple process:—Steep saffron in boiling soft water for about twelve hours; then, having slightly sewed up the tops of the gloves to prevent the dye from staining the inside, wet them over with a sponge dipped in the liquid. The quantity of saffron, as well as of water, will, of course, depend on how much dye may be wanted, and their relative proportions on the depth of the colour required.

TO TAKE IRON STAINS OUT OF MARBLE.

Mix equal quantities of spirits of vitriol and lemon juice; shake it well: wet the spots, and in a few minutes rub them with a soft rag till they disappear.

CHINESE MODE OF RENDERING CLOTH WATERPROOF.

By the following very simple process it is said that the Chinese render, not only the strongest cloth, but even the finest muslin, water-proof, without injuring the appearance or quality of the article. The composition to which these valuable articles are imputed, is merely a solution of half an ounce of white wax in a pint of spirit of turpentine. In a sufficient quantity of the mixture made with these materials, immerse the goods intended to be rendered water-proof, and then hang them in the open air till they become perfectly dry. This is all the process necessary for accomplishing so desirable a purpose; against which, however, may be objected, perhaps, the expense, and unpleasant smell of the turpentine. But this objection can be remedied by using equal parts of spirits of wine and oil of wormwood: a mixture of which is said to dissipate the smell of turpentine: but the former, it is not to be denied, must necessarily be augmented.

TO CLARIFY QUILLS.

Scrape off the outer film and cut the ends off; then put the barrels into boiling water, wherein is a small quantity of alum and salt; let them remain a quarter of an hour, and then dry them in an oven.

TO ASCERTAIN THE QUANTITY OF SPIRIT CONTAINED IN ANY LIQUOR.

For this method of ascertaining the strength of liquors, we are indebted to Mr. Brande. It destroys the commonly received opinion first entertained by Fabroni; namely, that the brandy or spirit obtained from wine is formed, during the distillatory process, by which means it is usually obtained; whilst, on the contrary, it clearly proves, that the brandy exists ready formed in all vinous liquors; and, hence, it may be separated from them without distillation, which may be done in the following manner.—Add to eight parts of the liquor to be examined, one part of a concentrated solution of sub-acetate of lead; a dense insoluble precipitate will ensue; it is the combination of the lead with the colouring extractive, and acid matter of the wine; shake the mixture for a few minutes, pour the whole upon a filter, and collect the filtered fluid. This fluid contains the brandy, or spirit and water, of the wine, together with a portion of the sub-acetate of lead, provided the latter has not been added in excess; in which case, a part, of course, remains undecomposed. Add, in small quantities at a time, to this fluid, warm, dry, and pure sub-carbonate of potass, which has previously been freed from water by heat, till the last portion added remains undissolved. The brandy or spirit contained in the fluid will thus become separated; for the sub-carbonate of potass attracts from it the whole of the water with which it was combined; the brandy or spirit of wine forming a distinct stratum, which floats upon

the aqueous solution of the alkaline salt. If the experiment be made in a glass tube from half an inch to two inches in diameter, and graduated into one hundred equal parts, the per-centage of spirit, in a given quantity of liquor, may be seen at a view.

By operating upon artificial mixtures of alcohol and water, Mr. Brande found, that, when the alcohol is not less than ten per cent., the quantity indicated by the dry and warm sub-carbonate of potass, after the colouring and acid matter had been separated by sub-acetate of lead, was always within one half-part in one hundred of the proportion contained in the mixture.

PASTE FOR SHARPENING RAZORS.

Take oxide of tin livigated one ounce, saturated solution of oxalic acid, a sufficient quantity to form a paste. This composition is to be rubbed over the strop, and when dry, a little water may be added; the oxalic acid having a great attachment for iron. A little friction with this powder gives a fine edge to the razor.

TO PRODUCE A FAC-SIMILE OF ANY WRITING.

The pen should be made of glass enamel, the point being small and finely polished, so that the part above the point may be large enough to hold as much or more ink, than a common pen.

A mixture of equal parts of Frankfort black and fresh butter is now to be smeared over sheets of

paper, and rubbed off after a short time. The paper thus smeared is to be pressed for some hours, taking care to have sheets of blotting-paper between each of the sheets of black paper. When fit for use, writing paper is put between the sheets of black paper, and the upper sheet is to be written upon with an enamel pen. By this method, not only the copy is obtained on which the pen writes, but also as many copies as there are sheets of white paper placed between black ones.

A very ingenious trick may be performed by means of this invention; the operator may propose that one of the company shall write his thoughts on a piece of paper, and hand the paper to a third person, when the operator will be enabled to give a ready answer to what he may have written, by privately inspecting the remaining sheets, where he will find a fac-simile of the writing.

THE ART OF VARNISHING AND JAPANNING.

To be proficient in this art several matters are required, and these you must consider as suitable, not only in property but goodness, that your cost and labour may not prove in vain.

As two strainers made of flannel, moderately fine, or of coarse linen, in the nature of a tunnel, for to strain your lack varnish, and the other for your

white varnish, and the first of these may serve for lackers, when your occasion requires you to make them; besides these are required two tunnels of tin for the same purpose as before; glass bottles and vials great and small must be in readiness, as to suit with the quantities of varnish your business requires you to use, and gallipots to put it in when you design to work; as also to mix your blacks in when they come to be ordered with other things.

As for tools they are no less requisite, for without them this art would be insignificant, and therefore to furnish yourself with them, you must have pencils according to the greatness or smallness of the things intended to work on; those for the varnish must be made of camel's hair very soft, and are of various prices, as to the largeness or fineness; likewise drawing pencils placed in duck or goose quills, as the fineness or largeness of the strokes require, and the longest haired pencils are accounted the best in this business; you must have in readiness a considerable number of muscle shells to mix colours and minerals in, as the occasion shall require it.

Dutch rushes are another material useful in this matter, to smooth the work before it is varnished, to get off the nobs or grittiness of the ground, or when it is varnished.

Tripoli is proper to polish this work with when varnished, being reduced into fine powder, and sifted: as for linen rags, you must be provided with them, both fine and coarse, to clear and polish this work, also olive oil for clearing; as many of these things shall be directed hereafter, as they occur in due place, in the work.

SPIRITS OF WINE.

This is of main use in varnishing, and if it be not properly qualified it will spoil the varnish, and not be capable, for want of strength, to dissolve your gums, or make them spread, and so completely lie uneven upon the work; and to know when this spirit is sufficiently rectified, put some of it in a spoon, and put a little gunpowder in, and if it burns out, blows up the gunpowder, and leaves the spoon dry, then it is a good spirit, but failing in this, and leaving the spoon moist when the flame extinguishes, it is not fit for your use.

GUM ANIMÆ, GUM LAC, AND GUM SANDARACK.

To choose these well, as for the first, get the most transparent, clearest, and whitest, which is the best.

The second also, called seed lac, choose that free from dross, sticks, or dust, large grained and quite bright.

As for the third, get that which is large, and very white, casting the least yellow, free from rust and dust.

SHELL LAC, WHITE ROSIN, BOLE AMMONIAC, AND VENICE TURPENTINE.

As for the first, that is best that is most transparent, will easily melt, and draw out with your fingers as fine as a hair.

As for the second, choose that for your use which is whitest and clearest.

As for the third, that is most fit for your purpose that is free from grittiness or gravel, and is of a blackish red colour, commonly called French bole.

GUM ELIMI, GUM ARABIC, AND GUM COPAL.

As for the first, choose the hardest, and freest from dirt and dross.

Choose the second, white and transparent.

As for the third, the best for your use is that which is the whitest, free from dross, and the thick dark stuff incorporated with it.

GAMBOGIUM, ISINGLASS, BENZOIN, AND DRAGON'S BLOOD.

There are other things necessary in this art, and ought to be well chosen.

As for the first, the best is that of a bright yellow, free from dirty thickness and dross.

Choose, as to the second, that which is whitest and clearest, and free from yellowness.

As for the third, the best is that of a bright red colour, much like to clarified rosin, free from all dross and filth.

The fourth, when the best, is of a bright red, free from dross, it may be had, as the others, at the druggists.

SILVER DUST, BRASS DUST, DIRTY GOLD, COPPER, POWDER, TIN, ETC.

The silver dust, the best is brought from beyond seas, and is known from the counterfeit by being squeezed between the finger and thumb, giving a glorious lustre, as indeed it does in the work.

Brass dust, by artists called gold dust, the best is made in Germany, and is of a bright colour, nearest resembling gold, try it as the silver dust; as for the coarse sort, though it will work pretty well with gold size, yet it will not do near so well, with gum water.

Green gold is a corrupt metal so called, is very good in this work, for casting a fading green colour.

Dirty gold is a corrupt metal, casting a dark dull though silverish colour, bearing pretty well a re semblance to dirty grossy gold.

Coppers are three sorts, natural, adulterate, and artificial; as for the natural, being cleansed, it may be ground without any mixture.

The adulterate is most fit for a ground, and serves most commonly to lay other metals on, as in etching or heightening gold or silver on; but the artificial is of a higher and brighter colour than either. There is also used in this art, those called speckles of copper gold, and silver, and divers other colours, differing in fineness, which may be worked as the artist fancies, either on the outside of boxes or drawers, or on mouldings, and may be purchased ready done.

COLOURS PROPER FOR JAPANNING.

Some of these are called transparent, on which gold and silver are to be laid, or some light colour, so that by this means they appear in their proper colours, lively and beautiful.

Of these, for a green, are distilled verdigrease: for a red, fine lake; for a blue, smalt; you have to grind these on a porphiry, or marble stone.

Grind with a mullet what quantity you please of smalt or verdigrease, with nut oil, as much as will moisten the colours and grind them till they are as fine as butter, then put the colours into shells, and mix them with oil of turpentine till they become thin, for use; lay them on silver, gold, or any other light colour, and they will then become transparent, altering their lightness or darkness according to that of the metal or colours that are placed under them; this for a curious red, may be done with lake, but then use drying oil to grind it with.

If you design figures on the back of your tables or boxes, as trees, birds, or flowers, those may be done, for white, with white lead; for blue, smalt, mixing it with gum arabic water, and mixing them as you please, to make them lighter or deeper; flake white is a very pure white, but the other will do for ordinary use; you may for a purple use russet, fine lake, and sea green, and it may be done with other sorts of reds or greens, and except transparent colours, all must be laid with gum water.

TO MAKE SEED LAC VARNISH.

Your ground work is good rectified spirits, of which, you may take a gallon, put it into as wide a necked bottle as you can get, that the gums may the better come out, then of the best seed lac, add a pound and a half, let it macerate twenty-four hours, or till the gums are well dissolved, with often shaking to keep them well together; then with flannel strainers strain it into a tin tunnel, placed in the mouth of the empty bottle, the strainer may be made as before directed, and squeeze the dross in the bag, and throw it away as of no use; then let the varnish settle, and pour it off into other bottles, till it rises thick and no longer; then strain the thick part and settle that again, and keep the fine varnish for your use, and this does well, without the danger of attempting to boil it, which endangers firing the house and the parties life.

TO MAKE SHELL LAC VARNISH.

This in curious glossy pieces of work is not of value, but in varnished woods it succeeds. To make it, put to a gallon of spirit, a pound and a half of the best shell lac, order it as the former, and tho' it has no sediment, it is proper, however, it should be strained, to take away the sticks or straws that may be in the gum, nor will it ever be fine and clear as the former, but turns in a few days to cloudiness, yet it is for coarse work, and much used.

TO MAKE WHITE VARNISH.

Take an ounce of common gum mastic, and an ounce of white gum sandarach, three ounces of the best and clearest Venice Turpentine, gum elemi half an ounce, gum copal an ounce and a half, gum Benzoin of the clearest, half an ounce, and half an ounce of white rosin, and the gums being separated in their quantities provided, put the rosin and copal in a glass vial, with half a pint of spirits, that they may be dissolved; and to the same end, in a glass bottle of three quarts of spirits put the Venice turpentine, anima, and Benzoin, and in another bottle the sum mastic and sandarach, in a pint and a half of spirits, then dissolve the gum elemi in a quarter of a pint of spirits, powder very finely the anima and Benzoin, the better to dissolve in the spirit, and then pour them into one large bottle, let them stand to fine as the former, then strain them through a linen cloth gently, not hardly pressing the sediment, lest you carry the grittiness of the gums along with you, to injure the varnish.

GENERAL RULES FOR VARNISHING.

This is a point nicely to be observed, or your labour and cost may be in vain.

1,—If you choose wood that requires to be varnished, let it be exempted from knots, very close grained, smooth, clean, well rushed, and freed from greasiness.

2.—As for your colours and blacks, lay them

even, and exquisitely smooth, sweep all roughness off with your brush.

3.—Keep your work ever warm, but not hot, to raise blisters, or crack it, which nothing but scraping off all the varnish can amend.

4.—After every distinct wash, let your work be thoroughly dry, for neglect in this point introduces the fault of roughness.

5.—After it is varnished, let it lie by and rest as long as your convenience will admit, and it will be the better.

6.—Ever take care to begin your varnish strokes in the middle of the table, or what you do it on, and not from one end to the other, and your brush being planted in the middle, strike it to one end, then take it off and fix it to the place you begun at, so draw or extend it to the other end, and so continue it till the whole plain be varnished over, and beware you overlay not the edges, which is when the varnish hangs in splashes or drops on them, and therefore to prevent it, draw your brush gently once or twice against your gally-pot side.

7.—When you have proceeded so far to come to polish, let your tripoly be very fine, and the finer the work, let it be still finer, and use fine rags, keeping your hand moderately hard upon it, and brighten or polish one place as much as you intend e're you leave it and pass to another, and always have regard, that you polish your work as smooth as you intend at one time, but if your convenience will admit, let it rest two or three days before you give the finishing strokes after you have polished it, but come not too near the wood, or make it thin or

hungry, for then it will require another varnish, or remain to your discredit.

8.—Take a sufficient quantity of tripoly at the first polishing, till it begins to come smooth, and so lessen by degrees, and carefully observe there be no scratches or gratings in it.

9.—When you have a mind to clear up the work wash off the tripoly with a sponge, and soak up the wet with a fair linen cloth, and with lamp black mixed with oil, gently smear the whole face of it, let no corner nor moulding of it escape, that the whole place may be freed, then with other linen, and a hard hand cleanse it of that, and these things done, there will be an admirable gloss.

BLACK VARNISHING OR JAPAN.

Provide first this imitation of japan, a close grained wood, well wrought off, rush it smooth and keep it warm by a fire, but never so near as to burn, scorch, or blister your work, then add to seed-lac varnish, as much lamp-black as will at the first strokes colour the wood; do it three times, permitting it to dry well between every time doing, and rush it well, then with a quarter of a pint of the thickest seed-lac, mixed with an ounce of Venice turpentine, put in more lamp black, so much as may well colour it, and with this wash it six times, letting it stand twelve hours between the first and three last washings; then with the finest seed-lac just tinctured with the black, do it over twelve times, letting it dry between every time of doing, after which let it remain five or six days before you polish it. For white let your polishing be gentle

and easy, do it nimbly, and clear it with oil and fine flour, and in observing these rules you will prove an artist.

At the end of that time, take water and tripoly, and polish it, having first dipped your cloth in water, and rub it till it gains a very fine smoothness and gloss, but do not rub so as it may any ways wear off the varnish, which cannot be easily repaired, then use a rag wetted without tripoly, and clear it up with oil and lamp black, yet polish it not all at once, but let it have some days respite between the first and last polishing, and at least three or four days.

WHITE VARNISHING OR JAPAN.

This must be curiously done without any soiling, and therefore you must be cautious of letting any dirty thing come near, whilst you are doing it.

To begin this work, scrape as much isinglass as will make it of a reasonable thickness, or when dipping your pencil in it, it will with a stroke whiten the body which has been passed over with a brush, but let it be in neither of the extremes, too thick nor too thin, then mix it with your size, whiten your work over with it, and when dry, repeat the same, covering it from all manner of dust before it is varnished; it must be whited three times, and dried between every one of them, smooth and lay it as close as you can to the wood with your rushes; then mix flake white with your size, only so that it may lie with a full and fair body on the piece, and whiten your work three several times with this,

drying between each, then make it with your rushes very smooth, but keep your distance from the wood.

In the next place, take white starch boiled in fair water till it come to be somewhat thick, and when it is lukewarm, wash over your work with it once or twice, drying between whiles, and let them stand twenty-four hours, then get the finest of the white varnish I have directed you to make, wash your pencil in spirits, and wash or anoint your work six or seven times, and after thirty or forty hours do the same again, and if done with a dexterous hand, a better gloss will be set on that if it had been polished; but if it miss of that gloss, it is requisite that you polish it; and in order thereto, you must accommodate it with five or six washes of varnish more than the former, and it must continue to settle well about a week before you polish it.

In polishing, your linen and tripoly must be the finest, being neat and careful in this operation, your hand carried light and gentle, having your cloth neither too dry nor too wet, and clear it up with fine flour and oil.

TO MAKE ISINGLASS SIZE.

Break and divide an ounce of isinglass into little pieces, put it into a glazed, clean, and well covered pipkin, and let it for twelve hours soak in a pint and a half of fair water, then place it over a gentle fire, till it boil well at leisure, and when the water is consumed to a pint, let it stand to cool leisurely, and then it will be a jelly, and may be used in the white varnish, and other works, but prepare no more

at a time than you will use, for in two or three days it will prove good for nothing.

TO MAKE RED JAPAN.

The reds are properly three, viz. the common red, the deep dark red, and the light pale red.

In the first vermilion is proper, mixed with the thickest of seed lac, warm the work and mix your vermilion with the varnish in a medium, carry it over in four times, permitting it to dry as the former; and if your reds be in a good body and full, rush it smooth, then with the ordinary seed lac varnish, wash eight times, and after twelve hours rush it again, and then for a curious outward covering, give it eight or ten washes with seed lac varnish, and after five days polish it, and clear it with lamp black and oil.

OF THE DARK RED.

The common red laid as before directed, deepen it with dragon's blood mixed with your own varnish, and when it has a pretty good colour go over it with lac varnish, which will much deepen and strengthen the colour, and in all things else, as to polishing and clearing, do as in the former red.

OF THE PALE RED.

To do this, grind white lead with a muller on a stone, and when it is finely done, mix it with so much vermilion as will make it a pale red, mix varnish with them, and give the work four washes,

and follow the prescription of the common red, considering well that the after varnish will heighten the colour.

AN OLIVE COLOURED JAPAN.

Take English pink colour, grind it with common size, and when it is like pulp, mix it with a proportion of lamp-black, and white-lead, and use it as in other japanning.

BLUE JAPAN.

To do this, grind white-lead very fine, add smalt as finely ground, mix them with isinglass size, the white lead grind with gum water, let there be a proportion of white and blue, and mix them well to the thickness of common paint, go over your work with it, and when it is well dried, proceed so four or five times, till the blue lies with a fair body, rush it smooth, and go over it again with a stronger blue, and when dry wash it with the clearest isinglass size, having a new pencil for that purpose, then when it is dry, warm it by the fire, and go over it with a pencil dipped in white wine varnish seven or eight times, and so let it continue for a day or two, then wash it as often as before, and so continue many operations at intermitted times, for a week at least must pass before you can well venture to polish it, and when it is polished, clear it with oil and lamp black.

Note, that in no wise you mix your colours with isinglass too strong, lest when dried they be apt to crack, fly, and spoil the piece; but when you

lay your wash of clear isinglass, to prevent your varnish from tarnishing, or soaking into your colours, then it is proper that it be of a full and strong body.

And thus much may very well suffice the learned to give him an insight into this excellent art, from whence I shall proceed to other things useful and profitable; and first to Gilding and Water size.

GILDING AND WATER SIZE.

To prepare this work, you must be furnished with parchment size, that is, the cuttings of parchment, boiled in fair water to a jelly, and when strained and cooled, it will prove a strong size.

When you are to use it, put as much as you shall want into an earthen pot, and make it hot, when it is cooling, scrape as much fine whiting into it as will colour it, mix them well with a clean brush, and with this mixture white your wood and frame, striking or jobbing your brush against it, that it may better enter into the hollowness of carved work, then give it rest, that it may dry.

This done, melt the size again, and put in more whiting, to render it some degrees thicker, and with this do over the frames seven or eight times, or as you see there is a necessity, and when it is dry open with a gouge no bigger than a wheat straw, the veins in the carved work that the whiting has stopped up, then with a fine wet rag with your finger,

carefully smooth and water, plain it over, and rush it smooth when dry, if necessity requires it; and in this condition it will well receive your gold or silver size. But before I proceed I shall teach you to prepare these sizes.

THE BEST GOLD SIZE.

Take an equal quantity of the best French and English bole ammoniac, grind these fine on a marble stone with fair water, then scrape into it a little grease, incorporate and grind all these well together, then mix a little quantity of parchment size with a double proportion of water, and the business is finished.

THE BEST SILVER SIZE.

Grind tobacco pipe clay very small, mix with it as much lamp-black as will turn it of a light ash colour, and to these add bits of candle grease, grind them very fine together, a mixture of size and water, and try these on the corner of the frame; if it be rough in burnishing put more oil or grease, and as near as you can bring it to a due temper, that it may use well.

TO SIZE FRAMES, &c.

To do this prepare the size blood warm, and with a fine brush stir it very well, till it is somewhat thin, go over the frames with it twice or thrice, yet touch not the hollow parts of the deepest carvings. where the gold cannot be conveniently laid, for the

yellow colour nearly resembling the first laid on, the fault will be soon discovered; let it dry four or five hours, and then try the gold if it will burnish on it, if not, alter the size, and do it over again.

TO LAY ON GOLD IN ORDER FOR BURNISHING.

Let your frame, or other matter intended, be set on an eazle, place the gold leaf on a cushion, to be held in your left hand with pallet and pencil, You must for this work with a swan's quill pencil, or a larger of camel's hair, if the work require it, dip it in water, and wet no more of your frame at a time than will take three or four leaves, make your beginning at the lower end, and so proceed upward, laying on whole leaves, or half ones, as it requires; then wet such another part of your work, and lay on the gold with your pencil, or cotton, gently pressing it very close; and having gilded the upright sides, turn the frame, and proceed the same way with the ends, then survey the spots and places that are omitted, and cut small parts of gold to cover them, when wetted, with a smaller pencil than before; when it is so finished, let it stand twenty-four hours after you leave off.

TO BURNISH GOLD WORK.

Take a wolf or dog's tooth, if you cannot get pebbles formed of the same shapes, and burnish so much of the work as you design, leaving the ground of the carving untouched, and some other parts, as

you see most convenient, which, in respect of burnishing, being rough, the better sets it off; that which is omitted to be burnished must be matted, or secured with seed lac varnish, or lacker; if you design it a deeper colour, then must your work be re possest, or set off with lacquer, mixed with saffron and dragon's blood, or the colour called annatto, and with a fine pencil dipped therein touch the hollowness of the carving, and the veins of the foldages or leaves; if you fancy it is not deep enough, you may by a repetition cause it to be so, and it is done.

TO LAY ON SILVER SIZE.

Warm the silver size that is newly ground and mingled with weak size, do it once or twice, and let it dry, and try the silver leaf, if it will burnish on it, it is prepared for use, but if it will not, make an alteration in the size, and for the rest lay on the leaf silver, and do as you did by the gold, and it will answer.

Note, as farther rules, and observe them.

1. Let your parchment size be somewhat strong, keep it not long, lest it spoil.

2. Grind no more silver or gold size than just you have occasion for.

3. Ever keep your work clean from dust, after it is sized and gilded, or else in the burnishing it will be full of scratches.

4. Do not whiten or burnish gold size in hard frosty weather, for then the whiting will be apt to peel off, and the gold straw.

TO STAIN WOOD IVORY, BONE, &c. DIFFERENT COLOURS.

TO DYE WOOD A CURIOUS RED.

The wood that takes this colour must be very white, and to begin it put a handful of alum in a moderate kettle of water, and cast your wood in it, and when well soaked, take it out, and put two handsful of rasped brasil wood, and when that has boiled well put the wood in again for a quarter of an hour boiling, and it will take the colour.

TO STAIN A CURIOUS YELLOW.

In this case, get the knotty ash or bur, that is very white, knotty and curled, smooth and rush it very well, and when it is well armed, wash it over with a brush dipped in aqua fortis, then hold it to the fire till it ceases smoking. Rush it again when dry, then polish it, and varnish it with seed lac, and it will be of a curious colour, not inferior to any outlandish wood; and if you put filings or bits of metal, as copper, brass, &c. each metal will produce a different tincture.

TO STAIN WOOD BLACK.

Boil logwood in water or vinegar, and two or three times brush or stain your wood with it when very hot; then get nut galls and copperas, bruise them well, and boil them in water, and with it wash or stain your wood so often, till it be perfect black; or rather steep it in hot liquor, if you can put it in, and the dye will penetrate the better.

TO DYE WOOD FOR INLAYING FLOWERS.

Get moist new horse dung, and squeeze out the moisture through a cloth, put it into several small vessels, fit for your purpose, and dissolve gum arabic and rock alum, each the quantity of a walnut, and with these mix reds, greens, blues, or any other colour to is suitable to the work, stir them often three or four days, then get your wood, particularly pear tree for white, cut it into the thickness of half crowns, or so much as will suffice any inlaid work, and in a square or length, according to your desire, boil up the liquor or colours very hot, and put in the wood till the colour has taken well; some indeed take out sooner, that the colour being less strong, may agree with your pasty-coloured flowers, shading, &c.

TO STAIN IVORY, BONE, OR HORN, RED

Soak some lime about twelve hours in fair rain water, then pour off the water from the settling through a linen cloth, and to each pint put half an

ounce of rasped brazil wood, and having boiled your materials in alum water, boil it in this, and it will give a curious tincture.

TO STAIN HORN, BONE, WOOD, OR IVORY GREEN.

Prepare your material by first boiling in alum water, then grind the common thick verdigrease, or Spanish green, a moderate quantity, adding half as much sal ammoniac, and put them into the sharpest wine vinegar, as also the materials you intend to stain, and let them stay there till they have a good tincture.

TO STAIN HORN, BOX, OR IVORY, A CURIOUS BLACK.

To do this, put small pieces of Brazil wood into aqua-fortis, and so continue them till they are green; then wash your materials in them, and boil logwood in water, into which put them whilst they are warm, and in a little time the ivory, &c., will be a curious black, so that being polished, it will appear like ebony or japan; and if you would have any part for flowers or the like, remain white, draw them before straining with turpentine varnish, and the black will not touch them, and clear up with oil and lamp black.

ON STAINING PAPER, PARCHMENT, &c.

TO STAIN PAPER OR PARCHMENT YELLOW.

Paper may be stained yellow by the tincture of French berries: but a much more beautiful colour may be obtained by using the tincture of turmeric, formed by infusing an ounce or more of the root of it, powdered, in a pint of spirit of wine. This may be made to give any tint of yellow, from the lightest straw, to the full colour called French yellow; and will be equal in brightness even to the best yellow died silks. If yellow be wanted of a warmer or redder cast, annatto, or dragon's blood, must be added to the tincture.

The best manner of using these, and the following tinctures, is to spread them even on the paper, or parchment, by means of a broad brush in the manner of varnishing.

TO STAIN PAPER OR PARCHMENT RED.

Paper, or parchment, may be stained red by treating it in the same manner as is directed for wood, or by red ink. It may also be stained of a scarlet hue

by the tincture of dragon's blood in spirits of wine; but this will not be bright.

A very fine crimson stain may be given to paper, by a tincture of the Indian lake; which may be made by infusing the lake some days in spirits of wine; and then pouring the tincture from the dregs.

TO STAIN PAPER OR PARCHMENT GREEN.

Paper, or Parchment, may be stained green, by the solution of verdigrease in vinegar; or by the chrystals of verdigrease dissolved in water. As also by the solution of copper in aqua fortis, made by adding filings of copper gradually to the aqua fortis, till no ebullition ensues; or spirit of salt may be used in the place of the aqua fortis.

TO STAIN PAPER, OR PARCHMENT, ORANGE.

Stain the paper, or parchment, first of a dull yellow, by means of the tincture of turmeric, as before directed. Then brush it over with a solution of fixt alkaline salt, made by dissolving half an ounce of pearl ashes, or salt tartar, in a quart of water, and filtering the solution.

TO STAIN PAPER, OR PARCHMENT, PURPLE.

Paper, or Parchment may be stained purple, by archal: or by the tincture of logwood, according to the method above directed for staining wood. The

juice of ripe privet berries expressed will likewise give a purple dye to paper or parchment.

TO PUT A CURIOUS BLACK ON LEATHER.

Take two pounds of the inward bark of old elder, the same quantity of the rush or filings of iron, put these into two gallons of rain water, and close them tight up in a vessel, and when they have stood about six weeks, put in a pound of nutgalls well bruised, a quarter of a pound of copperas, let them simmer a considerable time over a fire, and after twenty-four hours standing, and often stirring, pour out the liquid part, and go over your leather with it warm, and it produces a curious German black.

FOR A VELVET CRIMSON.

Dissolve cake-soap in fair water and bole ammoniac, each three ounces, place it over a gentle fire till the liquor grows clammy; then put in a little handful of grains of cochineal, two ounces of red lead, an ounce of lake, a quarter of an ounce of vermilion, and a little piece of indigo, beat these over a gentle fire till they are as thick as the glair of an egg; then go over the skin with a soft brush dipt in it, till the colour arises in your mind.

TO IMITATE TURKEY BLUE.

Take two ounces of smalt, a quarter of a pint of red wine, half a pint of vinegar, an ounce of white starch; incorporate these over a fire till they become a moderate thickness, then steep the skin in

alum-water, add to the composition a pint of water wherein gum arabic has been dissolved, and stir it well: go over the skins three times, drying them 'twixt whiles, so when well dried, polish them over, to make them glossy.

CEMENT FOR METALS.

Take gum of mastic ten grains, rectified spirit of wine two drachms; add two ounces of strong isinglass glue made with spirit, and ten grains of gum ammoniac; dissolve all together, and keep it stopped in a phial. When intended to be used, set it in warm water.

MAHOGANY-COLOURED CEMENT.

Melt together two ounces of bees' wax, half an ounce of India red, and a small quantity of yellow ochre, to bring it to a proper colour.

TO MAKE GUNPOWDER.

There is a considerable difference in the composition of the gunpowder of different nations. The government-powder of this country is the same for cannon as for small arms: the difference is only in the size of the grain. Gunpowder may be made in the following manner:—Take seventy five parts, by weight, of nitre, fifteen of charcoal, and ten of sulphur; let these articles be reduced to a fine powder: then mix them thoroughly together, and form them into a stiff paste with a little water; when this has been done, press the mass, after it is a

little dry, through a hair-sieve, to cut it into irregular grains, of such a size as may be wanted, and suffer the grains to dry; the powder may then be sorted and separated from the dust by sieves of progressive perforations; and, lastly, dry it thoroughly in a warm place. The power of this powder will depend greatly on the intimate mixture of the ingredients; particularly on the equal diffusion of the nitre; the more finely it is divided, and intimately blended with the sulphur and charcoal, the more instantaneous will be the combustion, and the expansive force greatly augmented.

TO CAUSE WATER TO BOIL BY THE APPLICATION OF COLD, AND TO CEASE TO BOIL BY THE APPLICATION OF HEAT.

Half fill a Florence flask with water, place it over a lamp furnace, and let it boil briskly for a few minutes; then cork the flask as expeditiously as possible, and tie a slip of moist bladder over the cork to exclude the air; the water, in being now removed from the lamp, will keep boiling, and when the ebullition ceases, the boiling may be renewed by wrapping round the empty part of the flask a cloth wetted with cold water; but if hot water be applied the boiling instantly ceases; in this manner ebullition may be renewed and again made to cease alternately, by the mere application of hot and cold water.

TO PRODUCE WHITE FIGURES UPON A BLACK GROUND.

Boil a piece of white muslin for a few minutes in a solution of sulphate of iron, composed of one part of green sulphate of iron and eight of water; squeeze it out and dry it: then imprint upon it spots, or any other pattern you choose, with lemon juice; render it dry again, and rinse it well in water. If the stuff now be boiled with logwood chips and water, it will exhibit white spots upon a black ground.

TO PRODUCE A CARMINE RED FLAME.

The flame of spirits of wine may be coloured by the addition of various bodies, which the spirit holds in solution, or which are mixed with it. And although the real causes which modify the colours of burning bodies are not sufficiently known, the phenomena are in themselves sufficiently striking to deserve to be stated in this place. The flame of alcohol is tinged red in the following manner:— Put into a small iron ladle one part muriate of strontia, and pour over it three or four of alcohol; then set it on fire with a candle or a piece of burning paper; it will burn with a bright carmine red flame, especially if the mixture be heated by holding the ladle over the flame of a candle or lamp, to cause alcohol to boil rapidly. The muriate of strontia, left behind as residue, after being again thoroughly dried, may be used for the same purpose repeatedly. The same holds good with all the

other materials employed for the productions of coloured fire, which will be stated presently.

PREPARATION OF MURIATE OF STRONTIA.

Dissolve native carbonate of strontia in muriatic acid evaporating the solution, and suffering it to crystallize.

TO PRODUCE AN EMERALD GREEN FLAME.

Cause alcohol to burn in a ladle upon nitrate of copper. Preparation of nitrate of copper. Let copper clippings or filings be dissolved in a sufficient quantity of nitric acid of a moderate strength; when no further effervescence ensues, boil the acid gently upon the copper until a pelicle appears; decant the solution, evaporate it slowly, and, when a very strong pelicle is formed, suffer it to crystallize; the salt is of a fine blue colour.

THE ART OF BLEACHING.

Take one quart of chlorate of lime (oxymuriate of lime), put it into a stone bottle, and pour over it eight parts of water. Let the mixture stand for twenty-four hours, during which time it ought to be now and then agitated; afterwards, decant the supernatant clear solution of chlorate of lime, dilute it with about three or four parts of water, and immerse into it any unbleached linen, which has acquired a yellow colour by age or frequent washing. If the steeped article, after having been in the

bleaching liquor for four or five hours, be then rinsed in the water, it will have acquired a beautiful white colour.

Spots and stains produced by red port wine, tea, fruit, and coffee, become also discharged by the action of this bleaching fluid, from white linen and cotton goods.

TO PRESERVE POLISHED IRONS FROM RUST.

Polished iron work may be preserved from rust by a mixture, not very expensive, consisting of copal varnish intimately mixed with as much olive oil as will give it a degree of greasiness, adding thereto nearly as much spirit of turpentine as varnish. The cast-iron work is best preserved by rubbing it with black lead. But where rust has begun to make its appearance on grates or fire-irons, apply a mixture of tripoly with half its quantity of sulphur, intimately mingled on a marble slab, and laid on with a piece of soft leather; or emery and oil may be applied with excellent effect; not laid on in the usual slovenly way, but with a spongy piece of the fig-tree fully saturated with the mixture. This will not only clean, but polish, and render the use of whiting unnecessary.

TO PREPARE THE SILVER TREE.

Pour into a glass globe, or decanter, four drams of nitrate of silver dissolved in a pound or more of distilled water, and lay the vessel on the chimney-

piece, or in some place where it may not be disturbed.

Now pour in four drams of mercury. In a short time the silver will be precipitated in the most beautiful arborescent form resembling real vegetation. This has been generally termed the Arbor Dianæ.

TO COLOUR STEEL BLUE.

The steel must be finely polished on its surface and then exposed to an uniform degree of heat. Accordingly, there are three ways of colouring, first by a flame producing no root, as spirit of wine: secondly, by a hot plate of iron; and thirdly by wood ashes. As a very regular degree of heat is necessary, wood ashes for fine work bears the preference. The work must be covered over with them, and carefully watched: when the colour is sufficiently heightened, the work is perfect. The colour is occasionally taken off with a very diluted marine acid.

TO MELT A COIN IN A NUT-SHELL.

Take three parts of nitre freed from its water of crystallization, one part of sulphur, and one of very fine dry saw-dust, and rub them intimately together. If a portion of this powder be pressed down in a walnut shell, and a small silver or copper coin rolled up be laid upon the powder in the shell, and the nut-shell be afterwards filled and heaped up with more powder, which should be pressed down close, and the powder be then set on fire by an

ignited body, the coin will be found melted in a mass when the combustion has been completed, whilst the nut-shell will be only blackened.

TO MAKE WAFERS.

Take very fine flour, and mix it with the glare of eggs, isinglass, and a little yeast; mingle the materials; beat them well together; spread the batter, being made thin with gum-water, on even tin plates, and dry them in a stove; then cut them for use. You may make them of what colour you please, by tinging the paste with Brazil or vermilion for red, indigo or verditer &c., for blue, saffron, turmeric, or gamboge, &c., for yellow.

TO MAKE TRANSPARENT PAPER FOR DRAWING.

Tracing paper is readily made, by taking a sheet of very thin silk or other paper, and rubbing it over gently with some soft substance filled with a mixture of equal parts of drying oil and oil of turpentine, which, suspended and dried, will be fit for use in a few days; or it may be had at any of the shops. Lay this transparent material on the print or drawing to be transferred, and, with a sharp black-lead pencil, trace the outlines exactly as they appear on the paper. If more permanent or stronger lines are wanted, ink mixed with ox gall will be necessary to make it adhere to the oiled surface.

METHOD OF USING TRACING PAPER.

Take a piece of the size required, and rub it equally over on one side, with black lead reduced to a powder, till the surface will not readily soil or finger; then lay a piece of white paper with the leaded side of this paper next to it, under the print; and securing them firmly together with pins at the corners, proceed to trace the outlines with a blunt point passed over the print. It may be corrected with the black lead pencil, and cleansed of any soil with crumbs of stale bread.

TO TRACE DRAWINGS.

There are two methods: one, to lay the print, &c, flat against a pane of glass, with thin paper over it, when the lines appearing through it are to be followed by the lead: the other is more convenient, and consists of a frame inclosing a square of glass supported by legs, on which the paper is laid as before, and a candle placed behind the glass. A pen and ink may be used in this manner; but they cannot in the former.

EASY MODE OF TAKING IMPRESSIONS FROM COINS.

A very easy and elegant way of taking the impressions of medals and coins, not generally known, is thus described by Dr. Shaw:—Melt a little isinglass glue with brandy, and pour it thinly over the medal, so as to cover its whole surface; let

it remain on for a day or two, till it is thoroughly dried and hardened; then taking it off, it will be fine, clear, and as hard as a piece of Muscovy glass, and will have a very elegant impression of the coin. It will also resist the effects of damp air, which occasions all other kinds of glue to soften and bend, if not prepared in this way.

PHOSPHORIC TAPERS.

Take a glass tube, about four inches long, and one or two lines in the bore, closed, at one end; introduce into a few grains of phosphorus previously dried on blotting paper. When this has been done, put a small taper, one extremity of which has been deprived of wax, into the tube, taking care that the end of the taper freed from wax touches the phosphorus. Then seal the open end of the tube hermetically, and plunge the other extremity into hot water, which will cause the phosphorus to melt and affix itself to the cotton of the wax taper, which, if then quickly drawn takes fire and burns rapidly.

TO GILD GLASS AND PORCELAIN.

Drinking and other glasses are sometimes gilt on their edges. This is done, either by an adhesive varnish or by heat. The varnish is prepared by dissolving in boiled linseed oil an equal weight either of copal or amber. This is to be diluted by a proper quantity of oil of turpentine so as to be applied as thin as possible to the parts of the glass intended to be gilt. When this is done, which will

be in about twenty-four hours, the glass is to be placed in a stove, till it is so warm as almost to burn the fingers when handled. At this temperature the varnish will become adhesive, and a piece of leaf gold applied in the usual way, will immediately stick. Sweep off the superfluous portion of the leaf; and when quite cold, it may be burnished, taking care to interpose a piece of very thin paper (Indian) between the gold and the burnisher. If the varnish is very good, this is the best method of gilding glass, as the gold is thus fixed on more evenly than in any other way.

TO GILD WRITINGS, DRAWINGS, &c. ON PAPER OR PARCHMENT.

Letters written on vellum or paper are gilded in three ways:—In the first, a little size is mixed with the ink, and the letters are written as usual; when they are dry, a slight stickiness is produced by breathing on them, upon which the gold leaf is immediately applied; and by a little pressure may be made to adhere with sufficient firmness. In the second method, some white lead chalk is ground up with strong size, and the letters are made with this by means of a brush; when the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The last method is, to mix up some gold powder with size, and to form the letters of this by means of a brush. It is supposed, that this latter method was that used by the monks in illuminating their missals, psalters, and rubrics.

TO GIVE SILVER PLATE A LUSTRE.

Dissolve alum in a strong ley; scum it carefully; then mix it up with soap, and wash your silver utensils with it, using a linen rag.

TO SUSPEND A RING BY A THREAD, AFTER THE THREAD HAS BEEN BURNED.

Soak a piece of thread in urine, or common salt and water. Tie it to a ring, not larger than a wedding ring. When you apply the flame of a candle to it, it will burn to ashes, but yet sustain the ring.

GLASS.

FLINT GLASS AND GERMAN CHRYSTAL GLASS.

Flint glass, as it is called in our country, is of the same general kind with what is in other places called chrystal glass. It had this name from being originally made with calcined flints, before the use of the white sand was understood; and, though no flints are now used in its composition, retain still the name.

It differs, however, from the German and other chrystal glass, in being partly formed of lead; whereas the fluxing bodies employed for the others are only salts or arsenic; and in having a white sand (which as is said before appears to be fragments of chrystal) for its body; instead of which calcined flints, or the white river pebbles, or other such stones, are used for the chrystal glass in other places; there being no sand of this kind of equal goodness found out of England, as far as is hitherto known.

The composition of flint glass is, therefore, principally the white sand and lead; to which a due proportion of nitre is added, to burn away the phlogiston of the lead: which otherwise imparts a strong yellow tinge to the glass; and to this is added, for hiding the remainder of the colour, a small quantity of magnesia: as also in some works a proportion of arsenic, to aid the fluxing ingredients. Flint glass is not, however, a simple glass of lead; for where no other salts are added, yet the quantity of the nitre used being considerable, and fluxing a proportionable quantity of the sand, it must be considered as a compound glass of salts and lead. But indeed it has been generally practised, to add some quantity of other salts to it; and diminish proportionably the quantity of lead otherwise necessary; which, though great in the glass made some time ago, seems to much diminished in that manufactured lately, at least in some works: as appears from the small weight and transparency of what is now to be met with; as well as from the vessels being blown much thinner, and of less substance,

than the glass in which lead abounds could well bear to be. The admission of lead into glass renders such glass less hard and transparent, than that made of salts only; but there is a power of reflecting the rays of light, of the same nature with that of diamonds and topazes, that gives a lustre and brilliant appearance to vessels of a round figure, not found in the mere glass; where the too great transparency, and want of play, give them a poorness or deadness in the look, when seen in the other; and this likewise extends itself in some degree to the appearance of liquors contained in them.

For polygonal vessels however, or those cut with flat sides, or such as are decorated with flowers or other ornaments cut in them, or with gilding, the glass of salts is preferable; as may be observed in the instance of those brought from Germany: but this must not be extended to such pieces as are cut with a great number of angles for the parts of chandeliers, or other purposes where the play of the light are wanted: for in all such cases, the glass formed with lead again takes place of the other; as producing a greatly stronger and more beautiful effect, for the reasons before given.

It appears from what has been said, that flint glass may be, as in fact it is, formed of various compositions, by altering the quantities of lead and nitre, and adding equivalent proportions of other salts or arsenic: in consequence of which, savings may be made in the expence, and a difference will arise in the hardness and softness of the glass; for the more the quantities of nitre or other salts are increased, and that of the lead diminished, the more hard and firm the texture of the glass will be: and

so vice versa. I will, therefore, give a recipe for the composition of a glass, according to each of the several manners, in which the proportions of the ingredients may be properly varied; and distinguish likewise, in each case, what the absolute and comparative qualities of the glass produced will be, and with respect to the comparative expence, the quantities of the several ingredients being thus stated, it will be very easy, for those who are acquainted with the market price of them, to make a fair computation.

THE MOST PERFECT KIND OF FLINT GLASS.

Take of the white sand an hundred and twenty pounds, of red lead fifty pounds, of the best pearl ashes forty pounds, of nitre twenty pounds, and of magnesia five ounces.

If this composition be fused with a very strong fire, and time be given to it, a glass will be produced, that will have the play of the best flint glass, and yet be hard and strong. It is not so cheap as the composition below, where arsenic or common salt is introduced, or where more of the pearl ashes are used; in either of which cases, savings may be made by diminishing proportionably the quantities of nitre; but the qualities of this glass will be found to come nearer to the standard of perfection; which is to unite the lustre and hardness together in the greatest degree, they are compatible with each other.

If this composition be, however, desired to flux

with less heat and quicker, a pound or two of arsenic may be added; which will be found effectually to answer the purpose.

FLINT-GLASS WITH A GREATER PROPORTION OF SALTS.

Take of sand one hundred and twenty pounds, of the best pearl-ashes fifty-four pounds, of red lead thirty-six pounds, of nitre twelve pounds, and of magnesia six ounces.

This will require much the same fire as the other; but will be harder in its texture; and have less of the refractive play of the light: it is, however, a very good composition of glass; and comes nearer to the kind now made: though I imagine the proportion of lead is still more diminished in some I have seen than here.

If it be desired to be made more yielding to the fire, arsenic may be added, as is directed for the preceding; or the quantity of sand may be lessened; but in that case the glass will be softer and weaker.

CHEAPER COMPOSITION OF FLINT-GLASS WITH ARSENIC.

Take of white sand one hundred and twenty pounds, of the best pearl ashes thirty-five pounds, of red lead forty pounds, of nitre thirteen pounds, of arsenic six pounds, and of magnesia four ounces.

This glass will require a considerable time in the

fire to become clear, and must not, if it can be avoided, be strongly urged at first; for the arsenic is apt to sublimate away, if the heat be violent before the other ingredients run into fusion so as to detain it. It is well, therefore, to mix a considerable proportion of glass, which has been wrought before and is to be manufactured over again with this composition when it is used; which, running sooner than the new mixt ingredients, will take hold of the arsenic, and fix it.

This composition should, however, be afterwards fused with a considerable heat; and continued in that state till the milky appearance of the arsneic, which it will sometimes retain for a long time, be entirely gone; for notwithstanding this apparent reluctance to perfect vitrification, the arsenic never fails at length to become very transparent glass; even to contribute greatly to render the other ingredients likewise. This glass will not be so hard as those of the above compositions; but it will be very clear, and may be employed for the formation of large vessels, where a sufficient thickness can be allowed to give them strength.

CHEAPER COMPOSITION OF GLASS BY MEANS OF COMMON SALT.

Take the proportions of the other ingredients given in the last; and, omitting the arsenic, add in its stead fifteen pounds of common salt.

This will be more brittle than the last; and therefore cannot be recommended unless for the

fabrication of such kind of vessels, or other pieces, where the strength is of little moment.

COMPOSITION OF FLINT GLASS BY THE ADDITION OF ARSENIC AND COMMON SALT.

Take of the white sand one hundred and twenty pounds, of red lead thirty pounds, of the best pearl-ashes twenty pounds, of nitre ten pounds, of common salt fifteen pounds, and of arsenic six pounds.

This glass will fuse with a moderate heat; but requires time, like the last, to take off the milky appearance of the arsenic; it is yet softer than the last; and may, therefore, be deemed the worst kind of flint-glass, that can be made, preserving the appearance of good glass to the eye; which it will have equally with any other kind when properly managed.

BEST GERMAN CHRYSTAL GLASS.

Take of the calcined flints or white sand one hundred and twenty pounds, of the best pearl-ashes seventy pounds, of salt-petre ten pounds, of arsenic half a pound, and of magnesia five ounces.

If the pearl ashes be pure and good, this glass will equal the best of this kind that ever was made. Borax has been frequently used also in the composition of this sort of glass; but its great price, without any equivalent advantage, will deter from the employing it in large manufactures: as there is no sort of transparent glass in common practice,

that of which looking-glass plates is made excepted, can bear the expence of it.

CHEAPER COMPOSITION OF GERMAN CHRYSTAL GLASS.

Take of calcined flints or white sand one hundred and twenty pounds, of pearl-ashes forty six pounds, of nitre seven pounds, of arsenic six pounds, and of magnesia six ounces.

This composition requires a long continuance of heat, on account of the arsenic, for the reason before given. It produces a glass equally, or more transparent, and colourless, than the deleterious qualities of the fumes, which will necessarily rise copiously till the effusion of the other ingredients check it, that, where the advantage is not more considerable than the saving arising from the difference of these two recipes, it is scarcely worth while to submit to the inconvenience of it.

GLASS FOR MIRRORS, &c.

The glass for forming the looking-glass plates in perfection is the most nice and difficult kind to manage, of any whatever; there being no latitude with respect to several of the qualities, as there is in the case of flint-glass, without its goodness being really impaired. These qualities are, to be entirely transparent and colourless; to have as little power of refracting the rays of light as possible;

to be entirely free from bubbles, specks and flaws, and to be fusible with a moderate heat. Hardness of consistence is of less consequence in this kind of glass, than in the flint; though it is an additional excellence; as far as it may be had along with the other qualities; since the plates may, in that case, be wrought thinner with the same degree of strength, which is of considerable advantage to mirrors made of them.

The white sand is the proper ingredient for forming the body of this kind of glass, as well as of the flint; and the principal part of the flux should be the fixed alkaline salt of vegetables; which the pearl-ashes will best furnish, when duly purified. This salt, however, must be aided by borax, or common salt; in order to facilitate the fusion, and prevent the glass from stiffening in that degree of heat, in which it is to be wrought into plates. Lead is by no means a proper ingredient in the composition of this kind of glass, on account of its augmenting the refractory power; and for the same reason arsenic, which has the like effect, though in a much less degree, should be either omitted, or but sparingly used. The sand should be carefully cleansed for this use, and the borax should be first calcined, and then rubbed to powder. The pearl-ashes must likewise be purified for this use, which must be done in the following way:

MANNER OF PURIFYING THE PEARL ASHES.

Take any quantity of the best pearl ashes, and dissolve them in four times their weight of water boiling; which operation may be best performed in a pot of cast iron. When they are dissolved let them be taken out, and put into a clean tub, and suffered to remain there twenty-four hours or longer. Let the clear solution be then decanted off from the dregs or sediment, and put back into the iron pot; in which the water must be evaporated away till the salts be left perfectly dry again. They should then if not used immediately, be kept in stone jars well secured from moisture and air, till such time as they are wanted.

Great care must be taken, in this treatment of the salts, to keep the iron pot thoroughly clean from rust, which would give a yellow tinge to the glass, not to be removed without greatly injuring it.

BEST COMPOSITION FOR LOOKING-GLASS PLATES.

Take of white sand cleansed sixty pounds, of purified pearl ashes twenty-five pounds, of salt-petre fifteen pounds, and of borax seven pounds.

This composition should be continued long in the fire; which should be for some time strong, and afterwards more moderate, that the glass may be en-

tirely free from bubbles before it be worked. It will be entirely clear of all colour, unless in case of some accident; but if any yellow tinge, should, nevertheless, unfortunately infect it, there is no remedy, except by adding a small proportion of magnesia, which should be mixed with an equal quantity of arsenic; and after their being put into the glass, giving it a considerable heat again; and then suffering it to free itself from bubbles in a more moderate one as before.

If the tinge be slight, an ounce of magnesia may be first tried; and if that prove insufficient, the quantity must be increased; but the glass will always be obscure, in proportion to the quantity that is admitted; though, perhaps, not in a degree, that may prevent it from passing currently with those who do not examine with great strictness.

This composition is not to be made without expence, at the times when borax is dear; but the great price which looking-glass plates, particularly such as are large, bear, will very well allow it; or even adding the greater quantity of borax, when there is occasion to have the glass run more easily, and roll in a less degree of heat.

CHEAPER COMPOSITION FOR LOOKING-GLASS PLATES.

Take of the white sand sixty pounds, of pearl ashes twenty pounds, of common salt ten pounds, of nitre seven pounds, of arsenic two pounds, and of borax one pound.

This glass will run with as little heat as the for-

mer; but it will be more brittle, and refract the rays of light in a greater degree; and, is, therefore, worse than the other in a greater degree, that is balanced by the saving in an article, where the cost of the materials is not considerable in proportion to the return; it being the work and skill, and not the ingredients, that make the high price of looking-glass plates.

It would be, therefore, unpardonable, while they continue to be sold at the dear rates they bear in this country, to impair the quality of the glass, for the sake of a trifling saving out of the original price of the materials.

GLASS FOR PHIALS.

The glass of which phials for the use of apothecaries, ink bottles, and many other such small vessels, are made, is a kind betwixt the flint glass and the common bottle or green glass. A very good sort of which may be thus prepared:

BEST PHIAL GLASS.

Take of white sand one hundred and twenty pounds, of unpurified pearl ashes fifty pounds, of common salt ten pounds, of arsenic five pounds, and of magnesia five ounces.

This will be a very good glass for the purpose; and will work with a moderate heat; but requires time to become clear, on account of the proportion of arsenic; when, however, it is once in good condition, it will come very near to the chrystal glass.

GREEN OR COMMON PHIAL-GLASS.

Take of the cheapest kind of white sand one hundred and twenty pounds, of wood ashes well burnt and sifted, eighty pounds, of pearl-ashes twenty pounds, of common salt, fifteen pounds, of arsenic one pound.

This will be green, but tolerably transparent, and will work with a moderate fire, and vitrify quickly with a strong one.

WRITING INKS.

BLACK WRITING INK.

The tinging matter of black inks is most generally borrowed from two substances, galls and logwood: for though Roman vitroil, coal of various substances, and other tinging or coloured bodies, have been sometimes used; yet they are either so much less efficacious, or so attended with discordant qualities as renders the galls, especially when conjoined with the logwood, greatly preferable to them. Galls are therefore by much the most common tinging substance employed for forming ink; though the colouring matter they contain is not in its natural state black; but being extracted by water

in the form of a tincture or infusion, requires to be conjoined with precipitated iron, in order to render it so. For this reason green vitriol or copperas is always added to the infusion or tincture of the galls; and being constituted of iron combined with the vitriolic acid, and analyzed by the essential oil that makes the tinging part of the galls, affords iron in that state proper for striking the black colour.

The nicety in the composition of inks lies in adequating the proportion of the vitriol to the galls; for in case of great error in this particular, the ink turns brown with time, and sometimes wholly disappears; as there may be found too many instances amongst the modern, as well as older writings. The adjusting the respective quantities of these two ingredients, cannot, nevertheless, be reduced to any certain rules that will always avail in every instance; because the difference in the strength of different parcels of the galls, and in the incidental circumstances of extracting the tinging matter from them, makes a great variation in the essential proportion with regard to the vitriol. This incertitude with respect to the durableness of the colour of the ink, as far as it depends on the galls, has introduced the use of logwood, as an auxiliary tinge; for it affords a gum soluble in water, that when struck with the precipitated iron, as well as any other alkaline body, becomes a deep purple or blue tinge; which, though not of itself strong enough to form a perfect ink, is yet of a sufficient force, combined with the brown of the iron, to support a legible colour in the ink, even if the galls fail and wholly lose their tinging power, as frequently hap-

pens: and even when no such miscarriage occurs, the purplish blue tinge of the logwood, conjoined with the black of the galls, gives a beauty and strength to the colour of the ink.

Privet berries have been likewise used in the same intention as the logwood; as they afford by pressure when ripe a juice of a very strong purple colour.

In order to make the ink work more freely, and have a greater body and more glossy appearance, sugar, and sugar candy, are frequently added in a small proportion. But there is another substance that produces this effect in a more perfect manner, and greater degree; which is the pomegranate peel; that added to the other ingredients, gives a shining appearance, and improves highly the effect of the ink.

Alum, as I before observed, is sometimes added to the ink: but it is not necessary where the pomegranate peel is used.

There are many recipes for forming ink of wine or vinegar, instead of water: though the practice is certainly very erroneous; for the wine, though it does not equally obstruct the effect of the galls as the vinegar, yet does in no degree contribute to the improvement of the qualities required in black ink: the vinegar, however, is not only unnecessary, but really detrimental to the effect of the galls; as it neutralizes the iron, and consequently destroys the tinging property of the galls, which depends upon it; and therefore occasions a very large quantity to be necessary for the producing even any black at all in the ink. This quality of the vinegar may be easily demonstrated, by the mixing a small

proportion of it with any ink tinged only with galls: for it will immediately destroy the blackness; and render the ink either brown, or colourless similar to water.

Spirit of wine, and brandy, are sometimes also added to ink, to prevent its growing mouldy: but care must be taken that the spirit be not commixt, with much of the acid used by the distillers in the rectification of it: for otherwise it will weaken the ink, and sometimes, as I have seen instances, even wholly destroy the colour.

COMPOSITION OF COMMON BLACK INK.

Take one gallon of soft water, and pour it boiling hot on one pound of powdered galls, put into a proper vessel. Stop the mouth of the vessel, and set it in the sun in summer, or in winter where it may be warmed by any fire; and let it stand two or three days. Add then half a pound of green vitriol powdered; and having stirred the mixture well together with a wooden spatula, let it stand again for two or three days, repeating the stirring; then add further to it five ounces of gum arabic dissolved in a quart of boiling water, and, lastly, two ounces of alum; after, which the ink should be strained through a coarse linen cloth for use.

The galls should be good, or the ink will fail, as it very frequently does from an error in this point. The marks of their goodness is, the appearing of a bluish colour, and feeling heavy. Where they are light in weight, and of a whitish brown colour, without any blue, they should be rejected, or a greater proportion should be used.

In all the recipes I have ever seen for ink, the gum arabic is ordered to be put undissolved into the mixture of water, galls, and vitriol; but however common, it is certainly a very injudicious practice; for as gum arabic is with some difficulty dissolved in simple water, and much more so in such as is acidulated by salts like the vitriol, and clogged likewise with the solid parts of the galls and precipitated iron, it is certainly much better to make a solution of it in part of the water of which the ink is to be formed, previously to its being commixed with the other ingredients; which would, otherwise, in spite of the most frequently repeated stirrings, keep it at the bottom of the vessel; and prevent its ever being wholly freed from them, and dissolved.

Boiling either the infusion of the galls, or the mixture after the addition of the vitriol, has likewise been frequently ordered, and practised; but it is not only needless, but injurious to the preparation of the ink; as it can have no effect on the vitriol, besides conducing to the solution of it, which is easily effected, in the proportion of water proper to be used, without any heat: and, with respect to the galls, their tinging power residing in an essential oil, that is volatile, and will rise with less heat than that of boiling water, it is necessarily lessened by the evaporation; and consequently, though more of it may be extracted from the galls, yet less will be retained in the fluid, that if infusion with a gentle heat be used, instead of decoction.

Having thus given the best means of preparing black ink in the common and simplest manner, I will subjoin a recipe for forming the most perfect

ink; which will be, nevertheless, found very little more expensive and troublesome than the common kind; though greatly superior with respect to the beauty of the colour, and the security of its standing well.

IMPROVED COMPOSITION OF BLACK WRITING INK.

Take a gallon of soft water, and boil in it a pound of chips of logwood for about half an hour. Take the decoction then off the fire, and pour it from the chips while boiling hot on a pound of the best Aleppo galls beaten to powder, and two ounces of pomegranate peels, being put into a proper vessel. After having stirred them well together with a wooden spatula for some time, place them in the sun shine in summer, or within the warmth of any fire if in winter, for three or four days, stirring the mixture again as oft as may be convenient. At the end of that time add half a pound of green vitriol powdered; and let the mixture remain four or five days more, stirring it as frequently as convenient; and then add further four ounces of gum arabic dissolved in a quart of boiling water; and after giving the ink some time to settle, strain it off from the dregs, through a coarse linen cloth, and keep it well stopt for use.

If the ink be desired to shine more, the proportion of the pomegranate peel must be increased: and in the country, where the logwood cannot be so easily procured, a pound of the ripe privet berries may be substituted for it.

In order to secure this ink from growing mouldy, a quarter of a pint or more of spirits of wine may be added: but to prevent its containing any acid, which may injure the ink, a little salts of tartar or pearl-ashes should be added previously, and the spirit poured off from it; which will render it innocent with regard to the colour of the ink.

These are the best recipes for the kinds of ink now in use; but for the sake of those who are fond of variety, I will add one recipe for an ink prepared on other principles, formerly sometimes used; and at first invented probably on account of some of that failure of the colour of the ink made of galls, which might be experienced, particularly when injudiciously prepared.

BLACK WRITING INK, WITHOUT GALLS, OR GREEN VITRIOL.

Infuse a pound of pomegranate peels, broken to a gross powder for twenty-four hours, in a gallon and a half of water; and afterwards boil the mixture till one-third of the fluid be wasted. Add then to it one pound of Roman vitriol, and four ounces of gum arabic powdered, and continue the boiling till the vitriol and gum be dissolved; after which the ink must be strained through a coarse linen cloth, and will be fit for use.

This ink is somewhat more expensive, and yet not near so good a hue, as that made by the preceding method; but the colour which it has is not liable to vanish or fade in any length of time: and therefore

very curious persons may have some satisfaction in being possessed of such a recipe.

PREPARATION OF A POWDER, FOR FORMING GOOD BLACK INK EXTEMPORANEOUSLY BY THE ADDITION OF WATER.

Infuse a pound of galls powdered, and three ounces of pomegranate peels, in a gallon of soft water for a week, in a gentle heat, and then strain off the fluid through a linen cloth. Add then to it, eight ounces of vitriol dissolved in a quart of water, and let them remain for a day or two; preparing in the mean time a decoction of logwood, by boiling a pound of the chips in a gallon of water, till one-third be wasted; and then strain the remaining fluid while it is hot.

Mix the decoction, and the solution of galls and vitriol, together; and add five ounces of gum arabic; and then evaporate the mixture over a common fire to about two quarts: when the remainder must be put into a vessel proper for that purpose, and reduced to dryness in balneo mariæ; that is, by hanging the vessel in boiling water. The mass left, after the fluid is wholly exhaled, must be well powdered; and, when wanted for use, may easily converted into ink, by the addition of water.

It was formerly the practice in compounding the portable inks, to mix the galls in substance with the other ingredients; and form the composition only of them with vitriol and gum arabic, powdered together! but besides the clogging, and fouling it, with the ligneous matter of the galls, there could

be no dependance on the standing of ink so imperfectly formed.

Compositions were also formerly made for portable, or extemporaneous inks, without galls or vitriol: of one of which the following is a recipe.

Take half a pound of honey, and the yolk of an egg; and mix them well together. Add two drachms of gum Arabic finely levigated; and thicken the whole with lamb black to the consistence of a stiff paste; which, put to a proper quantity of water, may be used as an ink.

PREPARATION OF RED WRITING INK.

Take of the rasping of Brazil wood a quarter of a pound, and infuse them two or three days in vinegar, which should be colourless where it can be so procured. Boil the infusion then an hour over a gentle fire, and afterwards filter it, while hot, through paper laid in an earthen cullender. Put it again over the fire, and dissolve in it, first half an ounce of gum Arabic; and afterwards of alum, and white sugar, each half an ounce.

Care should be taken that the Brazil wood be not adulterated with the Braziletto or Campeachy (commonly called peachy) wood; which is mostly the case, when it is good: and through a very detrimental fraud, in all instances of the application of Brazil wood to the forming bright red colours, cannot yet be perceived after the mixture of the raspings, but by trial in using them: it is therefore much the best way, when it is wanted for purposes like this, to procure the true Brazil wood in pieces and to scrape it with a knife, or rasp it with a very

bright file, (but all rust of iron must be carefully avoided) by which means all possibility of sophistication is of course prevented.

Red ink may likewise be prepared, by the above process, of white wine instead of vinegar; but it should be sour, or disposed to be so; otherwise, a third or fourth of vinegar should be added, in order to its taking the stronger tincture from the wood. Small beer has been sometimes used for the same purpose: but the ink will not be so bright: and the quantity of gum Arabic diminished, and the sugar wholly omitted.

RED INK FROM VERMILION.

Take the glair of four eggs, a tea-spoonful of white sugar or sugar candy beaten to powder, and as much spirit of wine; and beat them together till they be of the consistence of oil. Then add such a proportion of vermilion as will produce a red colour, sufficiently strong; and keep the mixture in a small phial or well stopped ink bottle for use. The composition should be well shaken together before it is used.

Instead of the glair of eggs, gum-water, is frequently used; but thin size made of isinglass with a little honey, is much better for the purpose.

GREEN WRITING INK.

Take an ounce of verdigrease, and having powdered it, put to it a qnart of vinegar; and, after it has stood two or three days, strain off the fluid; or use the chrystals of verdigrise dissolved in water.

Then dissolve, in a pint of either of these solutions, five drachms of gum Arabic, and two drachms of white sugar.

YELLOW WRITING INK.

Boil two ounces of the French berries in a quart of water, with half an ounce of alum, till one third of the fluid be evaporated; and then dissolve in it two drachms of gum Arabic, and one drachm of sugar; and afterwards a drachm of alum finely powdered.

INFLAMMABLE PHOSPHORUS.

Take the meal or flour of any vegetable, put it into an iron pan over a moderate fire, and keep it stirring with an iron spoon till it changes into a black powder; to one part of this add four parts of raw alum. Make the whole into a fine powder, put it again into the iron pan, and keep stirring it till it almost catches fire, to prevent its forming into lumps, as it is apt to do when the alum melts, in which case it must be broken again, stirred about, and accurately mixed with the flour, till it emits no more fumes, and the whole appears a fine dry black powder.

Put this powder in a clean dry phial with a narrow neck, filling it to about one-third of the top. Then stop the mouth of the phial with loose paper, so as to let the air pass freely through it, and leave room for fumes to come through the neck. Place the phial in a crucible, encompassed on all sides with sand, so that it may not touch any part of the

crucible, but a considerable space everywhere left between. The phial must be covered up with sand, leaving only a small part bare, by which you can discern whether the powder is ignited. In this state, the crucible is to be surrounded with coals, kindled slowly till it is well heated on all sides, and then the fire is to be raised, till the crucible and every thing in it is red hot; keep it in this state an hour: after this, the fire still burning as fiercely, close up the orifice of the phial with wax, to exclude the air. Leave it to cool, and you will find in it a black dusty coal formed of the flour and alum.

Shake a small quantity of this out of the phial into the air, it will immediately take fire, but will not burn anything. Keep the bottle dry, as even the air will spoil it effectually.

CURIOUS EXPERIMENTS WITH A VIPER.

Many natural philosophers, in their eagerness to display the powers of science, have overlooked one of the first duties of life, humanity: and, with this view, have tortured and killed many harmless animals, to exemplify the amazing effects of the air pump. We, however, will not stain the pages of this little work by recommending any such species of cruelty, which in many instances can merely gratify curiosity; but as our readers might like to read the effect on animals, we extract from the learned Boyle, an account of his experiment on a viper.

He took a newly-caught viper, and shutting it up in a small receiver, extracted the air; at first, upon

the air being drawn away, it began to swell; a short time after it gaped and opened its jaws; it then resumed its former lankness, and began to move up and down within the receiver, as if to seek for air. After a while, it foamed a little, leaving the foam sticking to the inside of the glass; soon after, the body and neck became prodigiously swelled, and a blister appeared on its back. Within an hour and a half from the time the receiver was exhausted, the distended viper moved, being yet alive, though its jaws remained quite stretched; its black tongue reached beyond the mouth, which had also become black in the inside; in this situation it continued for three hours; but on the air's being readmitted, the viper's mouth was presently closed, soon after opened again; and these motions continued some time, as if there were still some remains of life.

It is thus with animals of every kind; even minute microscopical insects cannot live without air.

WATER FIRE-FOUNTAINS.

To make a fire-fountain for the water, first have a float made of wood, three feet diameter; then in the middle fix a round perpendicular post, four feet high, and two inches diameter; round this post fix three circular wheels made of thin wood, without any spokes. The largest of these wheels must be placed within two or three inches of the float, and must be nearly of the same diameter. The third wheel must be one foot four inches diameter, and fixed within six inches of the top of the post; the wheels being fixed, take eighteen four or eight-

ounce cases of brilliant fire, and place them round the first wheel with their mouths outwards, and inclining downwards; on the second wheel place thirteen cases of the same, and the same manner as those on the first; on the third, place eight more of these cases, in the same manner as before, and on the top of the post fix a gerbe; then clothe all the cases with leaders, so that both they and the gerbe may take fire at the same time. Before firing this work, try it in the water to see whether the float is properly made so as to keep the fountain upright.

ALTERNATE ILLUSION.

With a convex lens of about an inch focus, look attentively at a silver seal on which a cypher is engraved. It will at first appear cut in, as to the naked eye; but if you continue to observe it some time, without changing your situation, it will seem to be in relief, and the lights and shades will appear the same as they did before. If you regard it with the same attention still longer, it will again appear to be engraved: and so on alternately.

If you look off the seal for a few moments, when you view it again, instead of seeing it, as at first, engraved, it will appear in relief.

If, while you are turned towards the light, you suddenly incline the seal, while you continue to regard it, those parts that seemed to be engraved will immediately appear in relief; and if, when you are regarding these seemingly prominent parts, you turn yourself so that the light may fall on the right hand, you will see the shadows on the same side from whence the light comes, which will appear not

a little extraordinary. In like manner the shadows will appear on the left, if the light fall on that side. If instead of a seal you look at a piece of money, these alterations will not be visible, in whatever situation you place yourself.

TO PRODUCE THE APPEARANCE OF A SPECTRE ON A PEDESTAL IN THE MIDDLE OF A TABLE.

Enclose a small magic lantern in a box, large enough to contain a small swing dressing-glass, which will reflect the light thrown on it by the lantern in such a way, that it will pass out of the aperture made at the top of the box, which aperture should be oval, and of a size adapted to the cone of light to pass through it. There should be a flap with hinges, to cover the opening, that the inside of the box may not be seen.

There must be holes in that part of the box which is over the lantern, to let the smoke out, and over this must be placed a chafing-dish of an oblong figure, large enough to hold several lighted coals. This chafing dish, for the better carrying on the deception, may be inclosed in a painted tin-box, about a foot high, with a hole at top, and should stand on four feet, to let the smoke from the lantern escape.

There must also be a glass planned to rise up and down in the groove, and so managed by a cord and pulley, that it may be raised up and let down by the cord coming through the outside of the box. On this glass, the spectre, (or any other figure you

please,) must be painted, in a contracted or squat form, as the figure will reflect a greater length than it is drawn.

When you have lighted the lamp in the lantern, and placed the mirror in a proper direction, put the box on a table, and setting the chafing-dish in it, throw some incense in powder on the coals. You then open the trap-door and let down the glass in the groove slowly, and when you perceive the smoke diminish, draw up the glass that the figure may disappear, and shut the trap-door.

This exhibition will afford a deal of wonder; but observe, that all the lights in the room must be extinguished; and the box should be placed on a high table, that the aperture through which the light comes out may not be seen.

There are many other pleasing experiments which may be made with the magic lantern, but the limits of our work will not permit us to specify them without excluding many other equally interesting subjects of a different nature.

THE BURNT WRITING RESTORED.

Cover the outside of a small memorandum book with black paper, and in one of its inside covers make a flap, to open secretly, and observe there must be nothing over the flap but the black paper that covers the book.

Mix soot with black or brown soap, with which rub the side of the black paper next the flap; then wipe it clean, that a white paper pressed against it will not receive any mark.

Provide a black lead pencil that will not mark without pressing hard on the paper. Have likewise a small box, about the size of a memorandum book, and that opens on both sides, but on one of them by a private method. Give a person the pencil and a slip of thin paper, on which he is to write what he thinks proper; you present him the memorandum book at the same time, that he may not write on the bare board. You tell him to keep what he writes to himself, and direct him to burn it on an iron plate laid on a chafing-dish of coals, and give you the ashes. You then go into another room to fetch your magic box, before described, and take with you the memorandum book.

Having previously placed a paper under the flap in the cover of the book, when he presses hard with the pencil, to write on the paper, every stroke, by means of the stuff rubbed on the black paper, will appear on that under the flap. You therefore take it out, and put it into one side of the box.

You then return to the other room, and taking a slip of blank paper, you put it into the other side of the box, strewing the ashes of the burnt paper over it. Then shaking the box for a few moments, and at the same time turning it dexterously over, you open the other side, and shew the person the paper you first put in, the writing on which he will readily acknowledge to be his.

If there be a press or cupboard that communicates with the next room, you need only put the book in the press, and your assistant will open it, and put the paper in the box, which you presently after take out, and perform the rest of the amusement as before.

There may likewise be a flap on the other cover of the book, and you may rub the paper against that with red lead. In this case you give the person the choice of writing either with a black or red pencil; and present him the proper side of the book accordingly.

HORIZONTAL WATER WHEELS.

To make horizontal wheels for water, first get a large wooden bowl without a handle; than have an eight-sided wheel made of a flat board eighteen inches in diameter, so that the length of each side may be nearly seven inches; in all the sides cut a groove for the sides to lie in. This wheel being made, nail it on the top of the bowl; then take four eight-ounces cases, filled with a proper charge, and about six inches in length. Now, to clothe the wheel with these cases, get some whitish-brown paper, and cut it into slips four or five inches broad and seven or eight long; these slips being pasted all over on one side, take one of these cases, and roll one of the slips of paper about an inch and a half on its end, so that there will remain about two inches and a half of the paper hollow from the end of the case; tie this case on one of the sides of the wheel, near the corner of which must be holes bored, through which put the packthread to the cases: having tied on the first case at the neck and end, put a little meal powder in the hollow paper; then paste a slip of paper on the end of another case, the head of which put into the hollow paper on the first, allowing a sufficient distance from the tail of one to the head of the other for the pasted paper

to bend without tearing: tie on the second case as you did the first: and so on with the rest, except the last, which must be closed at the end, unless it is to communicate to any thing at the top of the wheel, such as fire pumps or brilliant fires, fixed in holes cut in the wheel, and fired by the last, or second case, as the fancy directs: six, eight, or any number, may be placed on the top of the wheel, provided they be not too heavy for the bowl.

Before tying on the cases, cut the upper part of all their ends, except the last, a little shelving, that the fire from one may play over the other, without being obstructed by the case. Wheel carriages have no clay driven in their ends, nor pinched, but are always left open, only the last, or those which are not to lead fire, which must be well secured.

TO FORM FIGURES IN RELIEF ON AN EGG.

Design on the shell any figure or ornament you please, with melted tallow, or any other fat oily substance; then immerse the egg into very strong vinegar, and let it remain till the acid has corroded that part of the shell which is not covered with the greasy matter; those parts will then appear in relief, exactly as you have drawn them.

TO CHANGE BLUE WHITE.

Dissolve copper filings in a phial of volatile alkali; when the phial is unstopped, the liquor will be blue; when stopped, it will be white.

IRON TRANSFORMED INTO SILVER.

Dissolve mercury in marine acid, and dip a piece of iron into it, or rub the solution over the iron and it will assume a silver appearance.

It is scarcely necessary to say, that these transmutations are only apparent, though to the credulous it would seem that they were actually transformed.

TO GIVE SILVER THE COLOUR OF GOLD.

Dissolve in common aqua-fortis, as much silver as you please. To eight ounces of silver, take four ounces of hepatic aloes, six ounces of turmeric, and two ounces of prepared tutty, that has been several times quenched in urine. Put these to the solution of the silver; they will dissolve, but rise up in the glass like a sponge; this glass must therefore be large to prevent running over. Then draw it off, and you will have ten ounces of silver, as yellow as gold.

GOLDEN INK.

Take some white gum arabic, reduce it to an impalpable powder, in a brass mortar; dissolve it in strong brandy, and add a little common water to render it more liquid. Provide some gold in a shell, which must be detached, in order to reduce it to a powder. When this is done, moisten with the gummy solution, and stir the whole with a small hair brush, or your finger; then leave it for a

night, that the gold may be better dissolved. If the composition become dry during the night, dilute it with more gum water, in which a little saffron has been infused; but take care that the gold solution be sufficiently liquid to flow freely in a pen. When the writing is dry, polish it with a dry tooth.

A WATER, TO GIVE ANY METAL A GOLD COLOUR.

Take hepatic aloes, nitre and Roman vitriol, of each equal quantities: and distil them with water, in alembic, till all the spirits are extracted; it will at last yield a yellowish water, which will tinge any sort of metal a gold colour.

ILLUMINATED WRITING.

It is well known that if any words are written on a wall with solid phosphorus, the writing will appear as if on fire: but it is necessary to give this caution lest accidents should occur:—In using it, let a cup of water be always near you; and do not keep it more than a minute and a half in your hand, for fear the warmth of your hand should set it on fire. When you have written a few words with it, put the phosphorus into the cup of water, and let it stay a little to cool; then take it out, and write with it again.

THE METHOD OF PREPARING AND COLOURING MARBLED PAPER.

There are several kinds of marbled paper; but the principal difference of them lies in the forms in which the colours are laid on the ground; some being disposed in whirles or circumvolutions; some in jagged lengths; and others only in spots of a roundish or oval figure. The general manner of managing each kind is, nevertheless, the same: being the dipping the paper in a solution of gum-tragacanth, (or, as it is commonly called, gum-dragon); over which the colours, previously prepared with ox-gall and spirit of wine, are first spread.

The peculiar apparatus necessary for this purpose is, a trough for containing the gum-tragacanth and the colours; a comb for disposing them in the figure usually chosen; and a burnishing stone for polishing the paper. The trough may be of any kind of wood: and must be somewhat larger than the sheets of paper, for marbling which it is to be employed: but the sides of it need only rise about two inches above the bottom; for, by making it thus shallow, a less quantity of the solution of the gum will serve to fill it. The comb may be also of wood, and five inches in length; but should have brass teeth, which may be about two inches long, and placed at about a quarter of an inch distance from each other. The burnishing stone may be of jasper or agate; but as those stones are very dear, when of sufficient largeness, marble or glass may be used

provided their surface be polished to a great degree of smoothness.

These implements being prepared, the solution of gum tragacanth must be made, by putting a sufficient proportion of the gum, which should be white, and clear from all foulness, into clean water; and letting it remain there a day or two; frequently breaking the lumps and stirring it, till the whole shall appear dissolved, and equally mixt with the water. The consistence of the solution should be nearly that of strong gum-water, used in miniature painting; and, if it appear thicker, water must be added; or if thinner, more of the gum. When the solution is thus brought to a due state, it must be passed through a linen cloth, and being then put into the trough, it will be ready to receive the colours.

The colours employed for red are, carmine, lake, rose-pink, and vermilion: but the two last are too hard and glaring, unless they be mixed with rose-pink, or lake, to bring them to a softer cast; and with respect to the carmine and lake, they are too dear for common purposes:—for blue, Prussian blue, and verditer, may be used:—for yellow, Dutch-pink, and yellow ochre, may be employed:—for green, verdigris, a mixture of Dutch pink and Prussian blue, or verditer, in different proportions:—for orange, the orange lake, or a mixture of vermilion, or read lead, with Dutch pink:—for purple, rose pink and Prussian blue.

These several colours should be ground with spirit of wine, till they be of a proper fineness; and then, at the time of using them, a little fish-gall, or, in default of it, the gall of a beast should

be added, by grinding them over again with it. The proper proportion of the gall must be found by trying them; for there must be just so much as will suffer the spots of colour, when sprinkled on the solution of the gum-tragacanth, to join together, without intermixing or running into each other.

When every thing is thus prepared, the solution of the gum-tragacanth must be poured into the trough: and the colours, being in a separate pot, with a pencil appropriated to each, must be sprinkled on the surface of the solution, by shaking the pencil, charged with its proper colour, over it; and this must be done with the several kinds of colour desired, till the surface be wholly covered.

When the marbling is proposed to be in spots of a simple form, nothing more is necessary, but where the whirles or snail-shell figures are wanted, they must be made by means of a quill, which must be put among the spots to turn them about, till the effect be produced. The jagged lengths must be made by means of the comb above described, which must be passed through the colours from one end of the trough to the other, and will give them that appearance; but if they be desired to be pointed both ways, the comb must again be passed through the trough in a contrary direction: or, if some of the whirles or snail-shell figures be required to be added, they may yet be made by the means before directed.

The paper should be previously prepared for receiving the colours, by dipping it over night in water, and laying the sheets on each other with a weight over them. The whole being thus ready, the paper must be held by two corners, and laid in the

most gentle and even manner on the solution covered with the colours; and there softly pressed with the hand, that it may bear every where on the solution. After which, it must be raised and taken off with the same care; and then hung to dry across a proper cord, suspended near at hand for that purpose; and in that state it must continue, till it be perfectly dry.

It then remains only to give the paper a proper polish; in order to which it is first rubbed with a little soap; and it must then be thoroughly smoothed by the glass polishers, such as are used for linen, and called the calender glasses. After which it should be again rubbed by a burnisher of jasper or agate; or, in default of them, of glass ground to the highest polish: for on the perfect polish of the paper depends in a great degree its beauty and value.

Gold or silver powder may be used, where desired, along with the colours: and require only the same treatment as them; except that they must be first tempered with gum water.

METHOD OF TAKING OFF PAINTINGS IN OIL, FROM CLOTHS OR WOOD; AND TO TRANSFER THEM ENTIRE, TO NEW PIECES.

The art of removing paintings in oil from the cloth or wood on which they are originally done, and transferring them to new grounds of either kind of substance, is of very great use: as not only pictures may be preserved, where the canvass is so decayed and damaged, that they would otherwise

fall to pieces; but paintings on ceilings or wainscot, which, when taken away from the places where they were originally placed, would have little value, may be conveyed to cloths: and, by being thus brought to the state of other pictures, become of equal worth with those painted originally on canvas.

The manner in which this is done, is, by cementing the face of a picture to a new cloth, by means of such a substance as can afterwards be dissolved, and consequently taken off by water: destroying the texture of the old cloth, by means of a proper corroding fluid: and then separating the corroded parts of it entirely from the painting; after which, a new cloth being cemented to the reverse of the painting in its place, the cloth cemented to the front is in like manner to be corroded, and separated; and the cemented matter cleansed away by dissolving it with water, and rubbing it off from the face of the picture. The particular method of doing this, with most convenience, is as follows:—

Let the decayed picture be cleansed from all grease, that may be on its surface; which may be done by rubbing it very gently with crumbs of stale bread; and then wiping it with a soft linen cloth. It must then be laid, with the face downwards, on a smooth table covered with fan paper, or the India paper: and the cloth on the reverse must be well soaked with boiling water, spread upon it by means of a sponge, till it appear perfectly soft and pliable. The picture is then to be turned with the face upwards; and, being stretched in the most even and flat manner on the table, must be pinned down to it in that state, by nails driven in through the edge, at proper distances from each other.

A quantity of glue should be then melted, and strained through a flannel cloth, to prevent any gravel or other impurities from lurking in it; and when it is a little cooled, a part of it should be spread on a linen cloth, of the size of the painting, where it should be suffered to set and dry; and then another coat put over it: when this becomes stiff also, the glue should be again heated; and while it remains of such a heat as to be easily spread, it should be laid over the face of the picture, and a linen cloth immediately put over it in the most even manner, and nailed down to the picture and table at the edge.

The glue should not be used boiling hot, as that would hazard some of the more delicate colours of the painting; and the linen cloth should be fine and half worn, that it may be the softer, and lie the flatter on the surface of the picture; in order to which, it is proper to heat it till the glue be soft and pliable before it be laid on, and to compress each part gently with a ball formed of a linen rag tied round with thread.

The table, with the picture, cloth, &c., nailed down to it in this state; should be then exposed to the heat of the sun, in a place where it may be secured from rain, and there continued till the glue be perfectly dry and hard; at which time the nails should be drawn, and the picture and linen cloth taken off from the table.

The picture must now be again turned with the face downwards, and stretched and nailed to the table as before; and a border of wax must be raised round the edge, forming as it were a shallow trough with the surface of the picture; into which trough

should be poured a proper corroding fluid, to eat and destroy the threads of the original canvas or cloth of the picture. The corroding fluid used for this purpose may be either oil of vitriol, aqua fortis, or spirit of salt: but the last is preferable, as it will more effectually destroy the thread, and when it is so weakened by the admixture of water, as not to have any effect on the oil of the painting; whichever is used, it is necessary they should be properly diluted with water: to find the due proportion of which, it is expedient to make some previous trials, and when they are found to be of such strength, as to destroy the texture of the thread without discolouring it, they are in the due state. When the corroding fluid has done its office, a passage must be made through the border of wax at one end of it, and the fluid must be poured off, by inclining the table in the requisite manner: and the remaining part must be washed away, by putting repeated quantities of fresh water upon the cloth. The threads of the cloth must then be carefully picked out till the whole be taken away; but if any part be found to adhere, all kinds of violence, even in the least degree, must be avoided in removing them; instead of which, they should be again touched, by means of a pencil, with the corrosive fluid less diluted than before, till they will readily come off from the paint.

The reverse surface of the painting being thus wholly freed from the old cloth, must be then well washed with water, by means of a sponge, till the corroding fluid employed be thoroughly cleansed away; when being wiped with a soft sponge, till all the moisture, that may be collected by that

means, be taken off, it must be left till it be perfectly dry.

In the mean time a new piece of canvass must be cut the size of the painting, which now remains cemented to the linen cloth put on the face of it; and, the reverse of the painting being dry, and spread over with some hot glue, purified as before, and melted with a little brandy or spirit of wine, the new canvas must be laid on it, in the most even manner, while the glue remains hot: and settled to it by compression: which may be performed by thick plates of lead or flat pieces of polished marble. Great care should however be taken in laying them on, to prevent the edge from cutting or bruising the paint; as also, during the setting of the glue to take them off; and wipe them at proper intervals, to prevent their adhering to the cloth by means of the glue, which may be pressed through it. The lead or marble, by which the compressure is made, being removed when the glue is set, the cloth must be kept in the same state till the glue be perfectly dry and hard: and then the whole must be again turned with the other side upwards, and the border of wax being replaced, the linen cloth on the face of the painting must be destroyed by means of the corroding fluid, in the same manner as the canvass was before: but greater care must be taken with respect to the strength of the corroding matter, and in the picking out the threads of the cloth; because the face of the painting is defended only by the coat of blue which cemented the linen cloth to it. The painting must then be freed from the glue, by washing it with hot water, spread and rubbed on the surface by a sponge: which should be cleansed

frequently during the operation by dipping and squeezing it in clean water. The painting may afterwards be varnished as a new picture; and, if the operation be well conducted, it will be transferred to the new cloth in a present state.

When the painting is originally on wood, it must be first detached from the wainscot or ceiling where it was fixed; and the surface of it covered with a linen cloth, cemented to it by means of glue, in the manner before directed for the paintings on canvass. A proper table being then provided, and overspread with a blanket, or thinner woollen cloth, if laid several doubles, the painting must be laid upon it with the face downwards, and fixed steady: and the boards or wood on which it was done must be plained away, till the shell remain as thin as it can be made, without damaging the paint under it. The proceedings must afterwards be the same as were before practised in the case of the paintings on canvass; till that on the wood be in like manner transferred to a cloth or canvass.

The whole of the above operation must be managed with the greatest care, otherwise the painting will receive some damage: and so much nicety is required in the corrosion, and taking off the threads of the cloth, that it can scarcely be performed rightly, but by such as have had some experience in the matter. It is proper, therefore, for any person who would practise it in the case of valuable paintings, to try it first with some old pictures of little value, till they find they have the right method of proceeding; and even then in some instances, where the coats of paint lie very thin on the cloth, it is scarcely practicable without miscarriage. But,

as in the case of pictures greatly decayed, or paintings on wood taken from buildings that do not admit of being commodiously re-placed elsewhere, there can be no great loss, if a failure should happen; and a considerable advantage may accrue, if the experiment succeed: for which there is a good chance, if the operation be properly conducted, and the subject favourable; it is very well worth while to make the trial.

TO MAKE PRUSSIAN BLUE.

Take any quantity of blood; and evaporate it to dryness; continuing the heat till it become black; but avoiding the burning any part of it to ashes. Powder the dry matter; and mix it thoroughly with an equal weight of pearl-ashes; and calcine the mixture in an iron pot or crucible, on which a cover is put. The calcination must be continued so long as the matter emits any flame; the fire being raised to a considerable degree of heat at the end of the operation, and the matter must be then powdered, and put while yet hot in twelve times its weight of water; which must be again set on the fire to boil for the space of three quarters of an hour, or more. The fluid must then be filtered off through a thin flannel bag, from the part remaining undissolved; through which remaining part fresh water should be passed, before it be taken out of the filtering bag, to extract as much as possible of the solution: and the water thus passed through should be added to the quantity before filtered; after which, what is retained in the bag may be thrown away. In the mean time a solution should be made of alum, and

copperas calcined to whiteness, in proportion of two pounds of the alum, and two ounces of the calcined vitriol, to each pound of the pearl ashes used with the blood; which solution must be made by boiling the alum and copperas in five times their weight of water, and then filter them through flannel or paper where great nicety is required.

When the solution of the alum and copperas is thus prepared; it must be added to the lixivium filtered off from the calcined blood and pearl-ashes: from which mixture, the precipitation of a blackish green matter will soon ensue. After the precipitated matter has subsided to the bottom of the vessel, and the fluid appears clear over it, separate it from the green sediment, first by pouring off all that will run clear out of the vessel, and afterwards by straining off the remainder; and then put the green matter again into a vessel, that will contain as much fluid as it was before mixed with. Add spirit of salt to it afterwards, in the proportion of six ounces to every pound of the pearl-ashes used; and the green matter will then soon appear to be converted into a beautiful blue. Water must then be added, to wash off the spirit of salt: which must be renewed several times, till it comes off perfectly sweet; and the last quantity must be then strained off: and the blue sediment dried in lumps of a moderate size. The produce will be about three ounces for every pound of the pearl-ashes employed.

If the produce be desired to be made either of a lighter or darker hue, it may be done by increasing the proportion of pearl-ashes to the blood, to give a lighter kind, or the spirit of salt to the pearl-ashes,

to give a deeper kind: but the quantity will in the latter case be proportionably diminished.

The straining or filtering the lixivium through flannel is not so good a method as the doing it through paper: especially where the colour is wanted of a very great brightness and purity; and the water is best separated from the great sediment first produced, and afterwards from the blue one, by the same means; but in these cases a fine linen cloth much worn, though whole, should be laid over the paper. The colour when reduced to a proper consistence may be laid on chalk stones to dry; and a moderate heat may be also used for greater expedition, when required; but great care should be taken not to burn the matter. The calcination may be performed in a reverberatory furnace, such as is used by the chemists, or in the furnaces where metals are melted: for the crucible or pot containing the matter may either be surrounded by the coals, or placed over them, provided a sufficient heat be given to it.

Where larger quantities are to be calcined they may be very cheaply and commodiously managed in the Potter's, or Tobacco-pipe-maker's furnaces; being put into them along with the earthenware and pipes: and if the calcined matter in such case cannot be conveniently powdered while hot, and put into the water, the deviating from that part of the process may be dispensed with: not being absolutely necessary, if the matter be well powdered afterwards before it be put into the water.

LIGHT RED, OR LIGHT OKER.

This pigment is an oker of a light red colour, of the scarlet cast; which is very useful in carnations, and for many other purposes. It may be had of the colourmen: or may be made by calcining the yellow oker, till it requires the tint of orange or red desired. After the calcination it must be ground, and washed over, and then dried, either by heat, or without, as may be most expedient: but when it is had of the colourmen, it is generally already ground and prepared for use; though, as they are not so nice in common as to wash over the colours, that operation may be added to what they have done where the oker is desired to be perfectly fine.

POTATOE MORTAR.

E. Cadet-de-Vaux found mortar of lime and sand, and also that made of clay, greatly improved in durability by mixing boiled potatoes with it.

EXTINCTION OF FIRES.

When a chimney or flue is on fire, throw into the fire-place one handful after another of flower of sulphur. This, by its combustion, effects the discomposition of the atmospheric air, which is, in consequence, paralysed, or, in effect, annihilated.

SPECIFIC GRAVITIES.

Table showing the proportion per cent. of alcohol contained in different fermented liquors.

	PER CENT.
Port Wine	25.83
Ordinary Port	23.71
Madeira	24.42
Sherry	19.81
Lisbon	18 94
Bucellas	18.49
Cape Madeira	22.94
Vidonia	19.25
Hermitage	17.43
Claret	17.11
Burgundy	16.60
Sauterne	14.22
Hock	14.37
Champagne	13.80
Champagne (sparkling)	12.80
Vin de grave	13.94
Cider from 5.50 to	9.87
Perry (average)	7.26
Burton Ale	8.88
Edinburgh	6.20
Dorchester	5.56
Brown Stout	6.80
London Porter (average) ..	4.20
Brandy	53.39
Rum	53.68
Gin	51.60

The figures set down opposite each liquor, exhibit the quantity of alcohol per cent. by measure in each of the temperature of 60°. Port, Sherry, and Madeira, contain a large quantity of alcohol; the Claret, Burgundy, and Sauterne, contain less; and the Brandy contains as much as 53 per cent. of alcohol. In a general way, we may say, that the strong wines in common use, contain as much as a fourth per cent. of alcohol.

ELECTRO-ATTRACTION OF LEAVES.

The results of a French experimentalist have lately led him to conclude that the leaves, hairs, and thorns of plants tend to maintain in them the requisite proportion of electricity: and, by drawing off from the atmosphere what is superabundant, they also act in some measures as thunder rods.

POLISHING STONES.

The Hindoos polish all kinds of stones by means of powdered corundrum, mixed with melted lac. The mixture being allowed to cool, is shaped into oblong pieces, of three or four inches in length. The stone is polished by being sprinkled with water, and at the same time rubbed with three oblong masses; and the polish is increased by masses being used successively with finer grains.

INDIAN PLASTER.

All the fine plaster with which the walls of the houses are covered in India, and which is so much

admired by strangers, is composed of a mixture of fine lime and soapstone, rubbed down with water; when the plaster is nearly dry, it is rubbed over with a dry piece of soapstone, which gives a polish very much resembling that of well polished marble.

NEW PYROMETER.

A new air-thermometer has been invented by M. Pouillet, for the purpose of measuring degrees of heat in very high temperatures; an object hitherto of very difficult attainment. By means of this instrument it has been ascertained, that the heat of melted silver is 1677 degrees; of a mixture one part gold and three of silver, 1803 degrees: and of melted pure gold 2096 degrees.

ELECTRICITY.

It is curious to take a retrospective view of the mode in which the effects of the Leyden phial were announced to the world, on their first discovery. The philosophers who first experienced, in their own person, a shock attendant on the transmission of an electric discharge, were so impressed with wonder and with terror by this novel sensation, that they wrote the most ridiculous and exaggerated account of their feelings on the occasion. Muschenbrok states, that he received so dreadful a concussion in his arms, shoulders and heart, that he lost his breath, and it was two days before he could recover from its effects; he declared also, that he should not be induced to take another shock for the kingdom of France. Mr. Allemand reports, that the

shock deprived him of breath for some minutes, and afterwards produced so acute a pain along his right arm, that he was apprehensive it might be attended with serious consequences. Mr. Winkler informs us, that he threw his whole body into convulsions, and excited such a ferment in his blood, as would have thrown him into a fever, but for the timely employment of febrifuge remedies. He states, that at another time it produced copious bleeding at the nose; the same effect was produced also upon his lady, who was almost rendered incapable of walking. These strange accounts naturally excited the attention and wonder of all classes of people; the learned and the vulgar were equally desirous of experiencing so singular a sensation, and great numbers of half taught electricians wandered through every part of Europe, to gratify this universal curiosity.

It is on the nervous system that the most considerable action of electricity is exerted. A strong charge passed through the head, gave to Mr. Singer the sensation of a violent but universal blow, and was followed by a transient loss of memory and indistinctness of vision. If a charge be sent through the head of a bird, its optic nerve is usually injured or destroyed and permanent blindness induced; and a similar shock given to larger animals, produces a tremulous state of the muscles, with a general prostration of strength. If a person who is standing receive a charge through the spine he loses his power over the muscles to such a degree, that he either drops on his knees, or falls prostrate on the ground; if the charge be sufficiently powerful, it will produce immediate death, in consequence

probably of the sudden exhaustion of the whole nervous system. Small animals, such as mice and sparrows, are instantly killed by a shock from thirty square inches of glass. Van Marum found that eels are irrevocably deprived of life when a shock is sent through their whole body; but when only a part of the body is included in the circuit, the destruction of irritability is confined to that individual part, while the rest retains the power of motion. Different persons are affected in very different degrees by electricity, according to their peculiar constitutional susceptibility. Dr. Young remarks, that a very minute tremor, communicated to the most elastic parts of the body, in particular the chest, produces an agitation of the nerves, which is not wholly unlike the effect of electricity.

The bodies of animals killed by electricity, rapidly undergo putrefaction, and the action of electricity upon the flesh of animals is also found to accelerate this process in a remarkable degree. The same effect has been observed in the bodies of persons destroyed by lightning. It is also a well-established fact, that the blood does not coagulate after death from this cause.

EUDIOMETRY.

The measurement of the quantity of oxygen contained in atmospheric air, or, indeed, in any gas in which it is not intimately combined, is named eudiometry, and the instrument by which it is performed is the named the eudiometer. There are two modes of effecting this: either by presenting to the oxygen any substance having a strong affinity for

oxygen, or by exploding it with hydrogen in a strong glass vessel by means of the electric spark, and in either case estimating the quantity by the decrease in the bulk of the gas. In the first method, the substances usually employed to absorb the oxygen, are either phosphorus, sulphuret of potash, or nitrous gas, which latter substance, when used according to the directions of M. Gay Lussac, seems preferable to any other; these directions are as follows:—Take a very wide tuber tumbler, for example, invert it in water, and having introduced into it 100 parts of the air to be examined, pass into it 100 parts of nitrous gas. There is instantly exhibited a red vapour, which is nitrous acid gas, and which being very soluble in water, disappear speedily without agitation, and after a minute at most the absorption is complete; then transfer the residuum into a graduated tube, and it will be found that the absorption is almost uniformly 84 parts, provided atmospheric air was used; and as nitrous acid (the resulting compound) consists of three volumes of nitrous gas and one volume of oxygen, one-fourth of the absorption, equal to 21 parts, indicates the quantity per cent. of oxygen. M. Gay Lussac shows by numerous experiments, the accuracy of the above process in varied circumstances. There is this great advantage attending it; that the proportion of oxygen gas being estimated by an absorption four times greater than its own volume, the errors of experiment are reduced to one-fourth. The analysis of combustible gases, and the supporters of combustion, reciprocally by explosion with the electric spark, furnishes, when it can be applied, one of the most elegant and speedy me-

hods of chemical research; but is attended with some danger, from the liability of the tube to burst, if a close tube is used, or with a risk of failure from the ejection of the mercury when the tube is merely sealed by that fluid. This has given rise to several modifications of the apparatus, most of which are somewhat complex and costly; but that invented by Dr. Ure, and communicated by him to the Royal Society of Edinburgh, is at once simple, cheap, and effective. It consists of a glass syphon, having an interior diameter of from two-tenths to four-tenths of an inch. Its legs are nearly of an equal length, each being from six to nine inches long. One end is open and slightly funnelled; the other end is hermetically sealed, and has inserted near it by the blow pipe two platina wires. The outer end of one wire is incurvated across, so as nearly to touch the open end of the tube; the outer end of the outer wire is formed into a small hook, to allow a little spherical button to be attached to it when the electric spark is to be transmitted. To use it, the whole syphon must be filled with water or mercury, then plunge the open leg into a pneumatic trough, and introduce into it any convenient quantity of the gases from a glass measure tube, containing them previously mixed in determinate proportions. Then applying a finger to the orifice of the syphon, remove it from the trough, and transfer the gases into the sealed leg, by holding the syphon leg uppermost. Then bring the mercury to a level in both tubes, by adding or displacing a portion, and note carefully the volume of gas in the sealed leg, which should be graduated to one hundredth part of

a cubic inch. Then applying again the fore finger to the orifice, so as also to touch the end of the platina wire, bring the pendent ball or button to the electric machine, and transmit the spark. After the explosion, on gradually sliding the finger to one side, and admitting the air, the mercury will rise to the sealed leg more or less above that in the other; then pour in the mercury till the equilibrium be restored, and read off, as before, the bulk of the remaining gas, and the difference of the two volumes will denote the true quantity of oxygen without requiring any reduction or allowances. So perfectly is the shock of explosion deadened by the elasticity of the air confined between the finger and the surface of the mercury in the open end of the tube, that nothing but a slight push or pressure at the tip of the finger is felt, even when the included gas is inconsiderable and of a highly explosive nature; and the projection of the mercury or displacement of the gas is obviously impossible.

THE METHOD OF FOLIATING, OR SILVERING LOOKING GLASSES.

The foliating looking glasses is performed by fixing quicksilver on the reverse surface, by means of plates of tin; which amalgamating or combining with the quicksilver, takes away its fluidity, and renders it so tenacious, as to be compressed into a very thin coat or plate, capable of adhering to the surface of the glass.

There are several manners of laying the quic

silver and tin on the glass ; and it is by some practised, to use the quicksilver alone ; and by others, to compound with it tin and lead ; and bismuth has likewise been frequently used instead of them : but it is not necessary, when the operation is well conducted, to make any addition to the quicksilver. The following is one of the best methods hitherto practised.

A proper number of sheets of thin paper must be procured ; which paper should be of a soft spongy nature, like that called blotting paper. This paper must be spread on a table with a very level even surface, and fixed very firmly; or it is better to use a marble or slab: but so much only of the table should be covered, as may form an area of the same figure with that of the glass to be silvered, a little enlarged. Over the surface of the paper must be sprinkled some powdered chalk; with which it should be well levigated, and wholly clear of any gravel or impurities. Leaves of tin, which should be rolled or beaten very thin, must then be laid upon the paper sprinkled with chalk, in the most smooth and even manner ; and where there is occasion, on account of the size of the glass, to use more than one, they should be joined with great exactness, (rather suffering nevertheless the edge of the one to bear on the other, than leaving any deficiency) so that the whole surface of the paper may be perfectly covered.

Quicksilver is to be then poured upon these leaves of tin ; and spread over every part of it by a hare's foot, or the feathered part of a quill. Some sheets of very thin smooth paper, of which the kind called fan paper is best, must be then spread over the

quicksilver, leaving a margin beyond the quicksilver, and upon this paper the glass must be gently laid: and then, being pressed down with one hand, the sheets of thin paper must be gently drawn from under it with the other, by taking hold of the margin left for that purpose. The upper surface of the glass must then be covered with thick paper, and a considerable weight put over it, in order to press out all the quicksilver that is not fixed by the tin; as well as to make it adhere more firmly to the glass. When no more quicksilver appears to drain off, the weights and paper may be removed; and the operation will be completed.

Some, who use the bismuth, add half an ounce of it to the quicksilver; and make the amalgamation by melting the bismuth, and then taking it off the fire, putting in the quicksilver gradually; and stirring it with an iron rod, or a tobacco-pipe, till the whole be thoroughly incorporated: when the mass should be poured into cold water, to prevent the quicksilver from sublimating with the remaining heat.

It is proper, nevertheless, before this composition be used, to strain it through a cloth; and what remains, and will not be pressed through, may be added to the next quantity to be incorporated. The proportion of tin and lead, when they are used in the same manner, is generally a compound of equal parts, in the proportion, when together, of a fourth part of the weight of the quicksilver. It has been also formerly practised, to use a composition of two parts of bismuth, and one part of tin, with the same quantity of lead, and ten parts of the quicksilver.

When the glasses with angular surfaces, called diamond cut, are to be silvered, a border must be formed on the table, of the figure of the glass, which may be done by a moveable frame. The paper, leaves, &c. must be brought over this border, and the subsequent proceeding may be the same, as in the case of the plain surface; only taking great care that the glass be properly let down within the border, so as to bear every where both on that and the surface of the table.

Globes of glass may be silvered; but as no pressure can be given, the plates of tin cannot be used; and the quicksilver must therefore be rendered of a proper consistence, by amalgamating it with some of the other metallic substances. The most approved method of doing this is as follows:—

Take of quicksilver two parts, of bismuth two parts, and of tin and lead each one part. Melt the tin and lead together; and, when they are fluid, add the bismuth. When that is melted likewise, take them from the fire, and put the quicksilver gradually to them; stirring the mixture till the whole be united.

After the mass is become so cool, as not to endanger its breaking the glass, pour it into the globe to be silvered; using a funnel, which will carry it to the bottom of the globe. Move the glass then gently about, so that the amalgamated matter may flow over every part, and adhere to it; which will effectually silver the globe. When every part is covered, pour out the redundant quantity; and keep the glass still, till it be perfectly cool. If, during the operation, the mixture appear to set in the globe, and be not sufficiently liquid to flow about, and

cohere with the glass, a gentle heat must be administered, which will remedy this defect; and if, on the contrary, the matter appear too fluid, and have not sufficient tenacity to fix itself to the glass, it must be taken out, and an additional quantity of the bismuth, tin, and lead added, by means of a proper heat.

As it is very advantageous for those that have occasion to silver considerable quantities of looking-glasses, to know how to separate the quicksilver from the tin, or other ingredients, I will subjoin the direction for doing it in a very expedite and quick manner, with the assistance of a common fire, by means of an alembic, or still, which may be constructed in the following manner:—

Let a copper or iron pan be first made, of about ten inches in diameter, and about four or five inches depth. Over this let a cover be soldered on it, in which cover must be fixed a short tube for the pouring in the quicksilver, and taking out the recrement after the operation. This tube must have a stopper capable of being screwed into it, so as to render the joint good against any escape of the vapour of the quicksilver, when raised with the pan. In the upper part of the side of the pan must be soldered a gun barrel, of about four or five feet in length, in a sloping direction; the hollow of which barrel must communicate with the cavity of the pan, so that the fumes of the quicksilver may pass into it. The end of the barrel must also be bent downward, so that, when the pan is placed in a level situation on the fire, this end of the tube may be immersed in the vessel of water, placed aptly for that purpose. This vessel may be a common pail, or large earthen ves-

sel, or any other such, which will contain a gallon or more of water. When this apparatus is provided, the operation is to be performed in the following manner.

Take any quantity of the matter from which the quicksilver is to be separated; and put it into the copper or iron alembic or pan, and screw down the stopper in the hole of the tube through which the matter is put in. Place the pan then upon the burning coals in a common fire; raising the coals round the side; and bring the vessel of water under the bent end of the gun barrel, so that an inch or two of it may be within the water. The quicksilver will soon rise in fumes; which, passing into the barrel, will be condensed there, or on the surface of the water at the end of it; and will flow in drops into the water, and be collected at the bottom of the vessel. When the whole of the quicksilver first put in is thus brought over; which may be easily perceived by the cooling of the barrel, and the drops ceasing to fall into the water, the stopper in the small tube at the top may be taken out, and a fresh quantity of the mater put in: and the same may be repeated as often as there may be occasion.

When all the quicksilver is distilled over, the water may be poured from it out of the vessel: and being put into a basin, or other small vessel, it may be freed from the remaining moisture by means of a sponge. The tin, lead, &c., may, likewise, be taken of the alembic or pan, when it is grown cold.

INCOMBUSTIBILITY OF THE HUMAN BODY.

Both in ancient and modern times, numerous instances have been recorded of seeming insensibility on the part of individual human beings to the action of fire or intense heat.

The Roman poet Virgil relates that the priests of the temple of Apollo, on Mount Soracte, had the faculty of walking with naked feet over burning coals, and the priests of other temples in Rome used to attract great crowds by a similar peculiarity. In more modern days, when the ordeal by fire was a common and approved mode of determining the truth or falsity of weighty accusations, many instances are related where persons lifted and also walked over red-hot bars, or put red hot gauntlets on their hands, without suffering from such trials in the slightest degree. Admitting many of these stories to be fictitious, the weight of evidence is too strong for us to disbelieve all of them. Those cases seem most likely to be true where individuals offered, of their own accord, to undergo the fire-ordeal, in order to prove the justice of some charge or other. Thus, when the Empress Maria of Arragon had accused a young Italian count of endeavouring to tamper with her nuptial faith, and had so procured the death of the count, the widow of the deceased came forward and demanded to be admitted to the fiery ordeal, in order to prove his innocence. Her demand was acceded to, and on her holding in her hand a red-hot bar of iron for a considerable length of time without being burned, the

empress was held to be guilty of a false charge, and condemned to death in her turn.

Such cases were at the time deemed miraculous; but as the minds of men became more enlightened, there appeared grounds for believing that the power of resisting the action of fire was referable to natural and intelligent causes. Within the last two hundred years, every half century or so has been marked by the appearance of some itinerant exhibitor, whose person, in part or whole, evinced the power of enduring the action of fire or intense heat. Whether this property depended upon some peculiarity in the individual's constitution, or was acquired by art, is a question to which we shall refer afterwards, when we have described some of the feats of this remarkable class of persons.

In Paris, about the year 1677, an Englishman of the name of Richardson, attracted great attention by his performances with fire. He professed himself able to execute the following feats. He chewed live coals, and shewed them burning in his mouth; he melted sulphur, let it burn on his hand, put it, while in flames, on his tongue, and finally swallowed it; he put a burning coal on his tongue, cooked there a piece of raw flesh, and allowed the fire to be kept up with a pair of bellows for a quarter of an hour; he held a red-hot iron bar in his hands, and afterwards took it into his mouth, from which he threw it forcibly with his teeth; and, lastly, he swallowed melted glass and pitch, sulphur and wax melted together, and in flames, so that the flame came out of his mouth, and the mixture made as much noise in his throat, as if a hot iron were plunged in water. Such, ac-

cording to his own announcement, is the list of Richardson's performances; all of which he successfully executed, at least in seeming, since a French academician made an attempt to explain his feats on rational principles. The general opinion was, that the exhibitor was protected by a particular composition, which he rubbed over the parts exposed to the fire. Others thought that habit did a great deal in the matter, while the vulgar openly ascribed the whole to a compact with the devil.

About the middle of the eighteenth century, a Mr. Powell acquired great note on account of his fire-feats, and appears to have excited so much astonishment among the scientific men of London, as to be thought worthy of a medal from the Royal Society. Among his successors in the art was an individual named Lionetto, who exhibited in Paris and Naples. Since that time, feats with live coals, the ejection of flames and smoke from the mouth, &c. have become more and more common, and may be seen practised to a greater or less extent at almost every fair. But within the last half century, two persons have appeared, who have excelled all their predecessors in performances of this kind. The first of these was a lady named Signora Girardelli, better known while she was in Britain (which was about the year 1818) by the title of the Incombustible Lady. The other personge was Monsieur Chaubert, who delighted in the romantic title of the Fire-King. A most able article, to which we are largely indebted on the present occasion, appeared in one of the latter volumes of the (Constable's) Edinburgh Magazine, descriptive of the performances of Signora Girardelli, and investigating tho-

roughly the means by which she accomplished them. We cannot better elucidate any mystery that may hang over this subject, than by an account of the conclusions to which the writer of this article in question came, respecting the feats of Signora Girardelli.

The Signora was a pleasant-looking lady, above forty years of age. She seemed most anxious to satisfy her visitors by her fair performance of every thing she undertook, and to eradicate all suspicion of juggling and mystery. Her feats were of five kinds; 1. those with aqua-fortis (nitric acid); 2. those with boiling oil and melted wax; 3. those with melted metal; 4. those with hot metals; and, 5. those with lighted candles. Her experiments with aqua-fortis were as follows: She took a little aqua-fortis into her mouth, and, after holding it there a little, spat it out on some iron filings, in order to exhibit its strength by the orange fumes which were raised. She put some aqua-fortis on a plate, and put a halfpenny into it, on which it acted briskly; she then rubbed about the halfpenny till it was scoured bright. She put a halfpenny into the palm of her hand, and poured a little aqua-fortis upon it, and allowed them to act upon each other there a considerable time. Her hand was not at all discoloured by these experiments. When examined into, these feats with aqua-fortis do not appear very wonderful. The action of the acid on the copper was no proof of great strength, and it was the only proof given.

When the writer of the account afterwards tried the same experiments, he found that diluted aqua-fortis, which had more action on copper than in the

Signora's experiment, could be taken into the hand without discolouring it, and into the mouth without any other effect than that of setting the teeth on edge, and causing a flow of saliva. The fumes and the seeming causticity of the liquid, therefore, were deceptive, and the want of knowledge in the spectators was the true cause of their wonder. The experiments with boiling oil and melted wax were performed thus: "The Signora filled a small pan with Florence oil, boiled it, proved that it was boiling by coagulating the white of an egg in it, and then took a mouthful of the oil, which, after rinsing her mouth, she spat out into the brazier, to show, by its blazing, that it was really oil."

As the boiling point of oil is 600 degrees Fahrenheit, this would certainly appear a remarkable experiment. But our analyst observes, that the white of egg coagulates at 156 degrees, and that there was no proof that the oil was pure. A little water mixed with it would cause the appearance of ebullition at 212 degrees. The liquid, even in this case, would be very warm, but a great part of the wonder would be taken away. "The Signora applied melted sealing-wax to her tongue, and an impression of a seal was taken on it." The same experiment was afterwards ventured upon by the writer of the account, and he found that he could bear it without suffering more than a very transient impression of heat. The wax it is to be observed, was not dropt on the signora's tongue, but torn off from the stick with the seal. The saliva on the tongue, and the slow-conducting power of the wax, seem to preserve from injury in this case.

In none of these experiments, then, which are

among the common ones performed by the fire-eaters, is there any very great cause for wonder, when properly examined into. With regard to the feats with melted metal, the first was as follows: "The Signora dipped the point of her fingers repeatedly into melted lead, and at each time lifted a small portion to her mouth, spitting it out afterwards in thin chewed masses. Again, she poured a small quantity of melted lead into her mouth, and afterwards took from her mouth a chewed piece about the size of a drachm. Her last with melted lead was to strike repeatedly with the sole of her foot a considerable piece of the metal when it was barely congealed." As plumbers are quite accustomed to touch or draw the finger through melted lead without sustaining injury, there is a perfect possibility of explaining the Signora's power of touching the metal with her finger and foot, upon the supposition that, like the plumbers, she was accustomed to it. But the introduction of the melted lead into her mouth is certainly a feat of a more extraordinary kind. The writer of the account already mentioned could see no juggle on the part of the lady, and considers the experiment as the most striking of those she went through.

The next feats were with red-hot iron. "The edge of a shovel in that condition which set wood on fire, was drawn by the lady along the upper part of her foot and front of her ancle, over her arms also, and hair, without making any mark, or raising any smell or smoke! The shovel was never allowed to rest any sensible time on a spot. Another red-hot shovel was laid on a board, which it set fire to, and the Signora struck it repeatedly with

the sole of each foot until it was a little bent. The contact here was momentary. She also licked the red-hot shovel with her tongue, and a hissing noise was heard, as the spectators were taught to expect." Of these experiments, certainly the most remarkable were those made on the hands and arms, where the surface is dry. As for the tongue, it is distinctly understood that the saliva prevents the iron, when rapidly passed over it, from touching the cuticle. It is curious fact, that if the iron be at a black heat, the tongue will be burnt in each experiment, though uninjured at a red heat.

The insensibility of the dry arm and leg is, as we have said, the most remarkable point in the Signora's feats with the heated iron. It was observed, however, that she used the edge of the shovel alone, and that this edge had previously been cooled in some degree by setting fire to the wood. "The remaining feats of the lady consisted in passing a bundle of eight lighted (moulded and wax) candles slowly and steadily beneath each fore-arm, and also moving her foot over the flame in such a way as to show the light rising between her toes. This process blackened the parts with smoke, but affected them in no other way." This feat indisputably showed great insensibility to the effects of heat. Much seemed to depend upon the steady movement of the flame, an effect analagous to which is seen in the singeing of muslin, where the loose threads are burnt away by being passed over a red-hot cylinder.

These are the chief performances of one of the most dexterous and celebrated of the modern fire-eaters, as they are generally named. The conclu-

sion to be drawn from the preceding analysis is that, while every art was used by the Signora Girardelli to increase the ostensible magnitude and difficulty of the experiments, on the other had, every art was put in force to diminish their real difficulty. But, upon the whole, a remarkable power of resisting heat was fairly shown to be possessed by the Signora. On being questioned, she declared herself to be in possession of a secret composition on which the insensibility of her skin depended; but there is reason to think that she only found this a convenient way of answering such interrogatories. She asserted that she was able to remain in an oven while a leg of mutton was roasted. This feat could not depend on composition, for it would be difficult, indeed, to apply any thing of the sort to the membrane lining the lungs. Besides, there was no melting or evaporation on the application of the hot iron to her skin, which would most probably have been the case had any composition been rubbed over it. Her tongue, also, was perfectly red and clean. In short, after the minutest examination, the writer we have quoted arrived at the conclusion, that the Signora derived her insensibility to heat from some peculiarity of constitution, increased by repetition and habit, and a great dexterity in making her experiments. That there are constitutional differences between human beings in this respect, must have been observed by every one. Some persons cannot lift off a kettle filled with boiling water from the fire, while others can lift out a piece of live coal with their fingers. The power which laundresses acquire of handling hot irons, is a suf-

ficient example of the influence of habit in obviating the effects of heat.

It is due to candour, however, to say, that some of the fire-eaters do appear to use a composition for their skin. On observing a quantity of vapour to arise from Lionetto's skin, when touched by red-hot iron, Dr Sementini of Naples became convinced that some application to the skin was the cause of its insensibility, and instituted a number of experiments to discover what the application was. He naturally resorted first to acids, and discovered, that, by washing repeatedly with diluted sulphur, nitric, or muriatic acids, the skin became gradually less sensible to the action of heat, and he was enabled to pass a red-hot iron over it without injury. By accident, he made the further discovery, that hard soap, rubbed over it, increased greatly the power of resistance in the skin. By washing the tongue with diluted sulphuric acid, and afterwards with soap, he found that he could pass a red-hot iron over it with impunity. In short, he acquired, by slow degrees, the power of repeating all Lionetto's experiments. Dr Sementini, in this case, ascribes the whole effect to the applications made. We are inclined to attribute at least an equal share in it to habit or repetition.

Monsieur Chaubert, or the Fire-King, flourished only a few years ago. He distinguished himself by many feats resembling those of the Signora Girardelli, with the melted lead and red-hot metals. But the particular line in which Monsieur Chaubert shone most highly, was the endurance of heat in ovens and such like places. What he could endure in this way was very wonderful, though much of

the wonder has been removed by the experiments of Dr. Blagden and others, who have proved that the human body retains an equability of temperature under any circumstances.

Without previous trials of any kind, Dr. Blagden entered a room raised to a heat of 260°, and remained in it, while eggs and a beef-steak were roasted by the atmospheric heat. The steak was overdone in thirty-three minutes. In such a position, the suffering is in the lungs. Experiments of this order were gone through by Chaubert with greater ease than others could do them, and this ease might partly arise from constitution, and partly from repetition and habit. It was unfortunate that this person was not contented with the repute of being fire-king, but wished also to be thought poison-king. He gave out that he was proof against the whole generations of poisons, and made a shew of taking the deadly one called prussic acid in public. He even went the length of announcing his readiness to permit any gentleman to bring his own prussic acid, just as jugglers who allow themselves to be shot at, profess to let any gentleman bring his own gun. Unfortunately for Monsieur Chaubert, Mr. Wakley, editor of the Lancet, desirous either of exposing quackery, or of making a curious philosophical experiment, issued a public advertisement that he was about to come forward with a dose of his own prussic acid, in answer to Monsieur Chaubert's call, at the same time warning the fire-king of the consequences, and washing his own hands of all responsibility of the matter. The attention of the public being arrested on the subject, he found it convenient to leave London, and has never, to our

knowledge, been heard of since. It is possible that he may at this moment be sitting in an oven in the New World, beside a leg of mutton. The worst wish we have to give to him, is, that he may have the foresight to take in a knife and fork with him.

From all that has been said here on this subject, the reader will observe it to be our opinion, that the majority of the feats of these fire-eaters (to use their common name) are the result in part of a natural insensibility to heat in the individual, strengthened by long habit, and rendered more effective in display by all the little tricks and deceptions possible. A due degree of boldness and dexterity of hand would enable most people to go through a number of these feats at the first trial; and by practice, in many instances, the power of performing others might apparently be acquired:—*Chambers Edinburgh Journal.*

VARNISH FOR COARSE WOOD-WORK.

Take any quantity of tar, and grind it with as much Spanish brown as it will bear, without rendering it too thick to be used as a paint or varnish; and then spread it on the pales or other wood, as soon as convenient, for it quickly hardens by keeping.

This mixture must be laid on the wood to be varnished by a large brush, or house painter's tool: and the work should then be kept as free from dust and insects as possible, till the varnish be thoroughly dry.

It will, if laid on smooth wood, have a very good gloss; and is an excellent preservative of it against

moisture on which account, as well as its being cheaper, it is far preferable to painting, not only for pales, but for weather boarding, and all other kinds of wood-work for grosser purposes. Where the glossy brown colour is not liked, the work may be made of a greyish brown, by mixing a small proportion of white lead, or whiting and ivory black, with the Spanish brown.

PREPARATION OF IVORY FOR A GROUND FOR MINIATURE PAINTING.

Take the ivory leaves, or tables on which the painting is intended to be made; and, having properly cleansed it, rub it over with the juice of garlic.

This takes off that greasiness, which is so much complained of, as preventing the colours from taking on the ground; and which is not otherwise to be remedied by the use of soap, or even gall. It is, however, effectually removed by this expedient, which was imparted to a gentleman in England, by a lady eminent for her painting in this way in Italy.

THE CONVERSION OF GLASS INTO PORCELAIN, ACCORDING TO THE METHOD OF MR. RAUMUR.

The principle on which the transformation of glass to porcelain depends, is this:—that, as was observed before, porcelain being a glass imperfectly vitrified, it may possibly be produced, either by

making such compositions as will endure heat, and vitrify only to a less degree, without a proportionable progression, beyond that point, to a more perfect state: or by reducing such glass, as is perfectly vitrified, back to that state.

On this principle, Mr. Raumur established his invention of making porcelain of glass; and on experiment he found it was practicable, as well on the cheapest kinds, even that called the green glass of which bottles are made, as of the finer. The manner of effecting this change is as follows:—

The glass to be converted into porcelain should be first wrought into vessels, or other pieces, by the methods commonly used for glass; and when they are so wrought, they should be put into casettes such as are used for burning China.

Along with the pieces of glass must be put a mixture of equal parts of plaster of Paris and fine sand, so as to fill the casettes: not leaving the least interstice or void betwixt any of the pieces of glass. The casettes are then to have the covers put on them; and are to be placed one upon another, if there be more than one, and the dimensions of the furnace admit it: and then put into a proper furnace; to which may be either a common Potter's kiln, or any other furnace, where a similar heat may be given; and there they must be continued for the usual time given for making pots. After thus burning a due time, and the cassettes are become cold, the pieces may be taken out; but will no longer appear to be glass, but a very beautiful kind of china; which may be afterwards painted, or otherwise ornamented, exactly in the same manner as the real.

THE TRANSPOSABLE PIECES.

Take two guineas and two shillings, and grind part of them away, on one side only, so that they be but half the common thickness, and observe that they must be quite thin at the edge; then rivet a guinea and a shilling together. Lay one of these double pieces, with the shilling upwards, on the palm of your hand, at the bottom of your three first fingers, and lay the other piece with the guinea upwards in the like manner, in the other hand. Let the company take notice in which hand is the guinea, and in which the shilling. Then as you shut your hands, you naturally turn the pieces over, and when you open them again, the shilling and the guinea will appear to have changed their places.

THE PENETRATIVE GUINEA.

Provide a round tin box, of the size of a large snuff box, and in this place eight other boxes, which will go easily into each other, and let the least of them be of a size to hold a guinea. Each of these boxes should shut with a hinge, and to the least of them there must be a small lock, that is fastened with a spring, but cannot be opened without a key; —observe that all these boxes must shut so freely, that they may be all closed at once. Place these boxes in each other, with their tops open, in the drawer of the table in which you make your experiments; or, if you please, in your pocket, in such a manner that they cannot be displaced.

Then ask a person to lend you a new guinea,

and desire him to mark it that it may not be changed. You take this piece in one hand, and in the other you have another of the same appearance, and putting your hand into the drawer, you slip the piece that is marked in the least box, and shutting them all at once, you take them out; then shewing the piece you have in your hand, and which the company suppose to be the same that was marked, you pretend to make it pass through the box, and dexterously convey it away.

You then present the box, for the spectators do not yet know there are more than one, to any person in the company, who, when he opens it, finds another and another, till he comes to the last, but that he cannot open without the key, which you then give him, and retiring to a distinct part of the room, you tell him to take out the guinea himself, and see if it be that which he marked.

This amusement may be made more surprising, by putting the key into a snuff-box of one of the company, which you may do by asking him for a pinch of snuff, and at the same time conceal the key, which must be very small, among the snuff, and when the person, who is to open the box, asks for the key, you tell him that one of the company has it in his snuff-box. This part of the amusement may likewise be performed by means of a confederate.

THE TRAVELLING OF SOUND EXPERIMENTALLY PROVED.

There is probably no substance which is not in some measure a conducter of sound; but sound is much enfeebled by passing from one medium to another. If a man, stopping one of his ears with his finger, stop the other also by pressing it against the end of a long stick, and a watch be applied to the opposite end of the stick, or a piece of timber, be it ever so long, the beating of the watch will be distinctly heard: whereas, in the usual way, it can scarcely be heard at the distance of fifteen or eighteen feet.

The same effect will take place if he stop both his ears with his hands, and rest his teeth, his temple, or the gristly part of one of his ears against the end of a stick.

Instead of a watch, a gentle scratch may be made at one end of a pole or rod, and the person who keeps the ear in close contact with the other end of the pole, will hear it very plainly. Thus, persons who are dull of hearing, may, by applying their teeth to some part of a harpsichord, or other sounding body, hear the sound much better than otherwise.

If a person tie a poker, or any piece of metal, to the middle of a strip of flannel about a yard long, then press with his thumbs or fingers the ends of the flannel into his ears, while he swings the poker against any obstacle, as an iron or steel fender, he

will hear a sound very like that of a large church bell.

HOW FAR SOUND TRAVELS IN A MINUTE.

However it may be with regard to theories of sound, experience has taught us that it travels at the rate of 1142 feet in a second, or nearly thirteen miles in a minute. The method of calculating its progress is easily made known: when a gun is discharged at a distance, we see the fire long before we hear the sound; if then we know the distance of the place, and know the time of the interval between our first seeing the fire, and then hearing the report, this will shew us exactly the time the sound has been travelling to us. For instance, if the gun be discharged a mile off, the moment the flash is seen, I take a watch and count the seconds till I hear the sounds; the number of seconds is the time the sound has been travelling a mile.

LETTER-PRESS PRINTING INK.

Letter-press printing ink is a very smooth and jet black oil paint. The consistence and tenacity of the oil of this composition are greatly increased, and its greasiness diminished, by means of fire. Linseed oil, or nut oil, is made choice of for this use. The nut oil is supposed to be the best, and is accordingly preferred for the black ink, though the darker colour it acquires from the fire renders it less fit the red. It is said, that the other expressed oils cannot be sufficiently freed from their unctuous

quality. Ten or twelve gallons are set over the fire in an iron pot, capable of holding at least half as much more; for the oil swells up greatly, and its boiling over in the fire would be very dangerous. When it boils, it is kept stirring with an iron ladle; and if it do not of itself take fire, it is kindled with a piece of flaming paper or wood. It is found that mere boiling, without setting it on fire, does not give it a sufficiency of the drying quality. The oil is suffered to burn for half an hour or more, and is then extinguished by covering the vessel close, and excluding the air. The boiling is continued with a gentle heat, till the oil has obtained the proper consistency, in which state it is called varnish. It is necessary to have two kinds of this varnish, a thicker and a thinner, (for the greater or less boiling it has received,) which are occasionally mixed together, to suit different purposes; for that which answers well in hot weather, becomes too thick in cold, and large characters or type do not require such stiff ink as the small. The thickest varnish, when cold, may be drawn into threads, like glue; and the workmen taking out small quantities, from time to time, judge of the proper degree of boiling required, by testing its tenacity in that manner. The oil loses by its boiling one eighth of its weight. The varnish readily mingles with fresh oil, and it will unite with mucilages, into a mass that is afterwards diffusible in water. About one seventh part, by weight, of lamp black is added to the varnish, to give it the depth of colour. Boiled with caustic alkali, a soapy compound is formed, and printers availing themselves of this fact, are in the habit of cleaning their types by soap-makers' lees and a

brush. It is said that when very new oil is used in making ink, it does not dry with the addition of litharge, or the oil of turpentine, and these additions (which are not necessary in old oil) cause it to stick very hard to, and clog up the types.

RED AND OTHER COLOURED PRINTING INKS.

Red and other coloured printing inks are make from linseed oil, boiled, into a varnish, as described in the black ink, with the addition of some dry pigment of the required colour, which is ground up with the varnish, with a stone and muller in the manner of oil paint. Thus for preparing the bright red printing ink, vermilion is ground up with the varnish, in such quantity as will give the required depth of tint. In like manner for blues, yellows, oranges, greens, &c., the Prussian blue, indigo, orpiment, chrome, red and orange lead, verdigris, and in general the pigments used by house painters, are similarly combined with the varnish.

COPPERPLATE PRINTING INK.

Copperplate printing ink is of a somewhat similar kind to that used for type printing, but the oil is less boiled, and the varnish is in consequence much more fluid; and instead of lamp-black, they either use the black imported from Frankfort, (which is said to be the charcoal of vine twigs, prepared in a peculiar manner,) or when this cannot be procured,

or is too costly, the finest ivory black that can be obtained.

LITHOGRAPHIC PRINTING INK.

Lithographic printing ink differs from that used in typography, only in being a much thicker varnish; and the lamp black which is used as the colouring matter is not mixed with it in the mass, but small portions of the varnish are taken from time to time, as it is required, and the lamp-black then only ground up with it either for immediate or very early use.

THE HELIOMETER, OR ASTROMETER.

This is an instrument invented by Bougier, for measuring with exactness the diameter of the sun, moon, and planets. This instrument is a telescope, having two object-glasses of equal focal distance, placed side by side, so that the same glass serves for both. The tube of this instrument is of a conical form, large at the upper end (which receives the two object-glasses) than at the lower, (which is furnished with an eye-glass and micrometer.)—Hence, two distinct images are formed in the focus of the eye-glass, the distance of which depending upon that of the two object-glasses from one another, may be measured with the greatest accuracy.

HESLIOSCOPE.

A telescope fitted for viewing the sun, without dazzling the eyes, by being provided with object and

eye-glasses, that are coloured red or green. Huygenes used only a plain glass blacked over the flame of a candle, which he placed between the eye and the eye-glass.

HEMATIN.

The colouring principle of logwood, which is obtained by digesting alcohol for a day on the aqueous extract of logwood ; then filtering the solution, evaporating partially, and leaving the liquid to rest, hematin will be deposited in small chrystals, which, after washing with alcohol, are brilliant, and of a whitish red colour, having a bitter, acrid, and slightly astringent taste. Hematin forms an orange red solution with boiling water becoming yellow as it cools, but recovering with increase of heat its former hue. Excess of alkali converts, it first to a purple, then to violet, and lastly to brown. Metallic oxides combine with hematin, forming blue-coloured compounds. Gelatin throws down reddish floculi ; peroxide of tin and acid redden it.

HERMETICAL SEALING.

Hermetical sealing is used to densth the perfect closing of vessels so as to prevent the ingress or egress of the most subtle fluids or bodies. In stopping glass vessels, for chemical operations, it is usual to heat the neck until it is quite soft, and then twisting it by a pair of pincers ; sometimes a plug well luted serves the purpose effectually.

MAKING OF COKE.

The first operation is the preparation of the coal, to reduce it to the state of coke, which is accomplished either in kilns, or in the open air. The latter plan has been, and is still, the most extensively adopted, we shall therefore describe it the first. An oblong square hearth is prepared, by beating the earth to a firm flat surface, and paddling it over with clay. On this the peices of coal are piled up, inclining toward one another; and those of the lower strata are set upon their acutest angle, so as to touch the ground with the least surface possible. The piles are usually from 30 to 50 inches high, from 9 to 16 feet broad, and contain from 40 to 100 tons of coal. A number of vents are left, reaching from top to bottom, into which the burning fuel is thrown; and they are then immediately closed with small pieces of coal beaten hard in. Thus the kindled fire is forced to creep along the bottom, and when that of all the vents are united, it rises gradually, and bursts out on every side at once. If the coal contains pyrites, the combustion is allowed to continue a considerable time after the disappearance of the smoke, to extricate the sulphur, part of which will be found in white flowers on the surface. If it contain none, the fire is covered up soon after the smoke disappears, beginning at the bottom and proceeding gradually to the top. In 50, 60, or 70 hours, the fire is in general completely covered with ashes of char, formerly made, and in twelve or fourteen days the coke may be removed for use. In

this way a ton of ordinary bituminous coal commonly produces from 700 to 1,100 lbs of coke.

HYDROMETER.

An instrument for ascertaining the specific gravities of different liquids. The most common description of these instruments consists of a hollow ball, of either metal or glass, capable of floating in any known liquid, and having two stems, the lower one terminating in a weight, in order that the instrument may float with the stems upright, and the upper stem (which is of the same diameter throughout,) being graduated, to shew the destiny of the fluid by the depth to which it sinks; as the heavier fluids will buoy up the instrument more than such as are lighter.

In this way, however, it is clear that the stem must be of considerable thickness, in order that the instrument may have an extensive range, in which case the smaller differences of destiny will not be perceptible. To obviate this imperfection various contrivances have been restored to; one of the most common of which is, to construct the instrument as above described, but with a very slender stem, which is divided into 100 equal parts; and to provide a number of moveable rings, all of equal weight, any one of which being slipped over the stem, when the instrument floats in distilled water with zero on the stem at the surface of the water, will cause it to descend until the top of the scale be at the surface; and the destiny is estimated by the number of weights required to bring the lower part of the scale

below the surface, minus the number of divisions of the scale which remain above the surface.

The method of Fahrenheit is both simpler and more accurate. Fahrenheit's hydrometer consists of a hollow ball with a counterpoise below, and a very slender stem above, terminating in a small dish. The middle or half length (the stem,) is distinguished by a fine line across, and the instrument is always immersed up to this line by placing weights in the little dish abvove. Then as the part immersed is constantly of the same magnitude, and the whole weight of the hydrometer is known, this last weight added to the weights in the dish will be equal to the weight of fluid displaced; and if the gravity of water be represented by 1000, and the weight be divided into thousandth parts of the weight of the instrument when it sinks to the middle of the stem in distilled water, the number of weights required to sink the instrument to the mark on the stem when floating in any fluid, added to the weight of the instrument, or 1000, will represent the specific gravity of the fluid.

FIRE ENGINE.

The following description of an engine of this kind has been handed down to us by Mr. Clare, in his work on the Motion of Fluids, published in 1735. "Engines for extinguishing fires,' he observes, "are either forcing or lifting pumps, and being intended to project water with great velocity, their effect in great measure depends upon the length of their levers, and the force with which they are wrought. A common squirting engine which

was constructed on the latter principle, consisted of a large circular cistern, like a great tub mounted upon four small solid wheels, running upon axle-trees, which supported the vessel. A cover or false bottom, perforated with numerous small holes, was fixed inside the cistern, about a foot below the upper edge, and about three from the bottom. In the centre of the perforated cover was fixed a lifting pump, to the piston rod of which was attached a cross tree carrying two vertical connected rods, which were simultaneously worked up and down by manual labour, by means of two curved levers (similar to common pump handles,) on opposite sides of the machine. During the downward motion of the piston, a quantity of water passes through the valve on its upper surface, and gets above the piston, and during the ascending stroke, this water is driven with great velocity through a branch pipe provided with a flexible leather joint, or by a ball-and-socket motion screwed on to the top of the pump barrel. Between the strokes the stream is discontinued. This engine is supplied with water poured into the cistern by buckets, &c., the perforated cover before mentioned keeping back all such matters as would be likely to choke or injure the pump-work." A year after the great fire of London, that is, in 1667, an act of Common Council was passed "for preventing and suppressing fires for the future," in which, among other salutary provisions, was enacted that the several parishioners, the aldermen, and different companies, should provide a certain number of buckets, hand squirts, fire engines, &c.; which shows that these were the only contrivances then known for the

purpose. We may also infer that the fire engines were not much to be relied upon at that time, from the greater importance attached to hand squirts and buckets. With such inefficient means it is not to be wondered at that fires spread as they used to do, but, rather, taking into account the buildings of that period, that they were extinguished at all. Towards the close of the seventeenth century, M. Duperrier, in France; Leupold, in Germany; and Newsham, in England, introduced, almost contemporaneously, fire engines of a very improved description, which soon came into general and extensive use. The most novel and important feature of these engines consisted in the employment of an air chamber, which rendered the stream of water continuous and uniform; together with the equally important and valuable addition of the flexible leathern hose, of any requisite length, invented by the brothers Jan Van der Heide, and first tried by them at Amsterdam, in the year 1672. These contrivances enabled the stream of water to be conveyed a considerable distance from the engine, and directed upon the flames with the greatest precision and effect. In the engines of Leupold, Duperrier, and some others, one working cylinder only was employed in conjunction with an air vessel. These machines very much resembled the common garden engines of the present day, which are too well known to require describing in this place. Newsham used two cylinders; and the following description of his fire engine will be read with much interest, when it is considered that, so perfect was his machine, at the expiration of above a century we still find it nearly as he left it.

Various convenient alterations and improvements have in the course of this period been made in the details of this engine, but the general character and mode of construction adopted by Newsham have not yet been surpassed.

BRONZE FOUNDING.

The Egyptian bronze consisted, according to Bessari, of two-thirds brass and one-third copper. Pliny says, that the Grecian bronze was formed by adding one-tenth lead and one-twentieth silver to the two-thirds of brass, and the one-third copper of the Egyptian bronze: and that this was the proportion afterwards made use of by the Roman statuaries. The modern bronze is commonly made of two-thirds copper, fused with one-third of brass; and recently, owing to the great demand for ornaments and decorative furniture of this alloy, lead and zinc in small proportions have been added to the copper and brass. These additions, it is said, increase the fusibility of the alloy, and facilitate the process of casting. Bronze casting is employed in forming equestrian statues, colossal and other figures in alto relievo, to adorn public places, its peculiar tint finely contrasting with the stone or marble of architecture, especially when the artist displays taste in his design and skill in his execution. The casting in bronze is performed in the following manner; first, the figure or pattern to be cast must have a mould, and this is prepared and laid on a plaster cast, previously wrought and finished by the sculptor. The mould is made of plaster of Paris, moistened with water, to which is added

brick-dust in the proportion of one-third of the former to two-thirds of the latter. This is carefully laid on the mould, with strength in proportion to the weight of metal intended to be used in the founding. In its joints should be cut small channels tending upwards and from different parts of the internal hollow, to allow of vent for the air to escape, as the heated metal runs in upon the mould. A thin layer of clay should be spread over the inside of it, and of the thickness which it is intended the bronze should be. Withinside of the clay a filling-up of plaster and brick-dust, in the proportions as before described, will be required to compose the core; but if the work to be cast be large, before the plaster and brick-dust are poured into the mould to form the core, a skeleton, composed of iron bars, as a support for the figure, should be prepared and fixed; after which the filling up of the core may be proceeded in. When this is done, the mould must be opened again, the layer of clay taken out of it, and the bore thoroughly dried, and even burned with a charcoal fire, or with straw; for if the least damp remain, the cast will be blown to pieces when the hot metal comes in contact with it, in running it into the mould, and the workmen employed about the work be maimed or killed by the dispersion of the heated bronze. After the core, &c, has been properly dried and is deemed ready for the work, it should be laid in the mould, and supported in its place by short rods of bronze, which should run through the mould into the core. All being so far advanced, the mould should be clad and bound round with iron, of strength proportionate to the size of the work to be cast, after which the mould

should be laid in a situation for running in the metals, and must be supported for that purpose by bricks, &c. Great care should be taken that every part be perfectly dried before any metal be run into the mould, or, as has been before observed, the most fatal consequences will arise to those who may be about the work. A channel must be made from the furnace in which the melted metal is, in order to its running to the principal jet of the mould, and with a descent to promote its flowing rapidly. The jets, furnace, &c. &c. are all contrived, same as for casting figures in brass.

EASY METHOD OF BREAKING GLASS IN ANY DIRECTION.

Dip a piece of worsted thread into spirits of turpentine, wrap it round the glass in the direction that you wish it to be broken, and then set fire to the thread; or apply a red-hot wire, a quarter of an inch thick, round the glass, and if it does not immediately crack, throw cold water on whilst the wire remains hot.

SALT OF LEMONS.

Take equal parts of nitric and tartaric acid powdered very fine, and mix them well together: it is used for taking out iron moulds, &c.

FLOUR PASTE.

This is formed of wheaten flour stirred in water till glutinous, and then boiled; when required very

strong, a fourth, fifth, or sixth, of powdered resin may be added.

CHINESE PASTE.

Mix together bullocks' blood and quick lime in proportions of one pound of the latter to ten pounds of the former; it becomes a stiff jelly, in which state it is sold to the consumers, who beat it down with the addition of water into a state sufficiently fluid for use.

TO WELD TORTOISE SHELL.

Provide a pair of pincers, the tongues of which will reach four inches beyond the rivet; now file the tortoise shell clean to a flat-joint, carefully observing that there be no grease about it; wet the joint with water, apply the pincers hot, follow them with water, and the shell will be found to be joined as if it were originally the same piece.

GAS-LIGHTS.

To imitate, in miniature, the production of gas-lights, put common coal into the bowl of a tobacco-pipe, cover the coal closely with clay, made into a stiff paste with water, and, when the clay is dry, put the bowl of the pipe into the fire and heat it gradually. In a few minutes a stream of carburetted hydrogen gas will issue from the end of the tobacco-pipe, accompanied with an aqueous fluid, and a tenacious oil or tar. The gas may be set fire to with a candle, and will burn with a bright flame.

When no more gas is disengaged, there will be found in the bowl of the pipe the coke or coal deprived of its bituminous matter.

TO DETECT ADULTERATION IN BREAD.

Run into the crumb of a loaf, one day old, the blade of a knife considerably heated; and, if adulterated with alum, it will show its unwholesome adherences on the surface; and it may be further detected by the smell. Bone-dust, or plaster of Paris, may be discovered by slicing the soft part of a loaf thin, and soaking it in a large quantity of water in an earthen vessel, placed over a slow fire three or four hours. Then, having forced off the water and pap, the obnoxious matter will be found at the bottom.

EASY METHOD OF MAKING A RAIN GUAGE.

A very simple rain guage, and one which will answer all practical purposes, consists of a copper funnel, the area of whose opening is exactly ten square inches; this funnel is fixed in a bottle, and the quantity of rain caught is ascertained by multiplying the weight in ounces by 173, which give the depth in inches and parts of an inch. In fixing these guages, care must be taken that the rain may have free access to them; hence the tops of buildings are usually the best places. When the quantities of rain collected in them at different places, are compared, the instruments ought to be fixed at the same heights above the ground at both places, be-

cause at different heights the quantities are always different even at the same place.

CURIOUS EXPERIMENT ON RAYS OF LIGHT.

That the rays of light flow in all directions from different bodies without interrupting one another, is plain, from the following experiment:—

Make a little hole in a thin plate of metal, and set the plate upright on a table, facing a row of lighted candles standing near together; then place a sheet of paper or pasteboard at a little distance from the other side of the plate; and the rays of all the candles, flowing through the hole, will form as many specks of light on the paper as there are candles before the plate; each speck as distinct and large as if there were only one candle to cast one speck; which shews that the rays do not obstruct each other in their motions, although they all cross in the same hole.

THE POWER OF WATER.

Let a strong small iron tube of twenty feet in height be inserted into the bung-hole of a cask, and the aperture round so strongly closed, that it shall be water-tight; pour water through the pipe into the cask till it be full, also continue filling the pipe till the cask bursts, which will be when the water is within a foot of the top of the tube. In this experiment the water on the bursting of the vessel, will fly about with considerable violence.

MICROSCOPIC EXAMINATION OF THE BLOOD.

By the aid of Tully's achromatic microscope, and under highly magnifying powers, it has recently been discovered that the globules of the blood congeal into flat circular bodies, and arrange themselves in rows, one body being placed partly underneath another, and in like manner as a pile of similar coins, when gently thrown down, would be found to arrange themselves. This curious effect has been attributed to the vitality yet remaining in the blood, during the act of congealing. At any rate it is a most singular fact, for although we might naturally conceive that the flattened circular plates would place themselves in juxta position, yet we never could have supposed that they would partly have slipped underneath each other. In order to make this very curious experiment, it is necessary that the blood, as freshly drawn, be slightly and thinly smeared over the surface of a slip of crown, or window glass, and be covered with a very thin slip of Bohemian plate glass; and thus some slight inequalities in the thickness of a layer of blood between them will be produced, and which are necessary to succeed in producing the very curious appearances above-mentioned.

FINIS.

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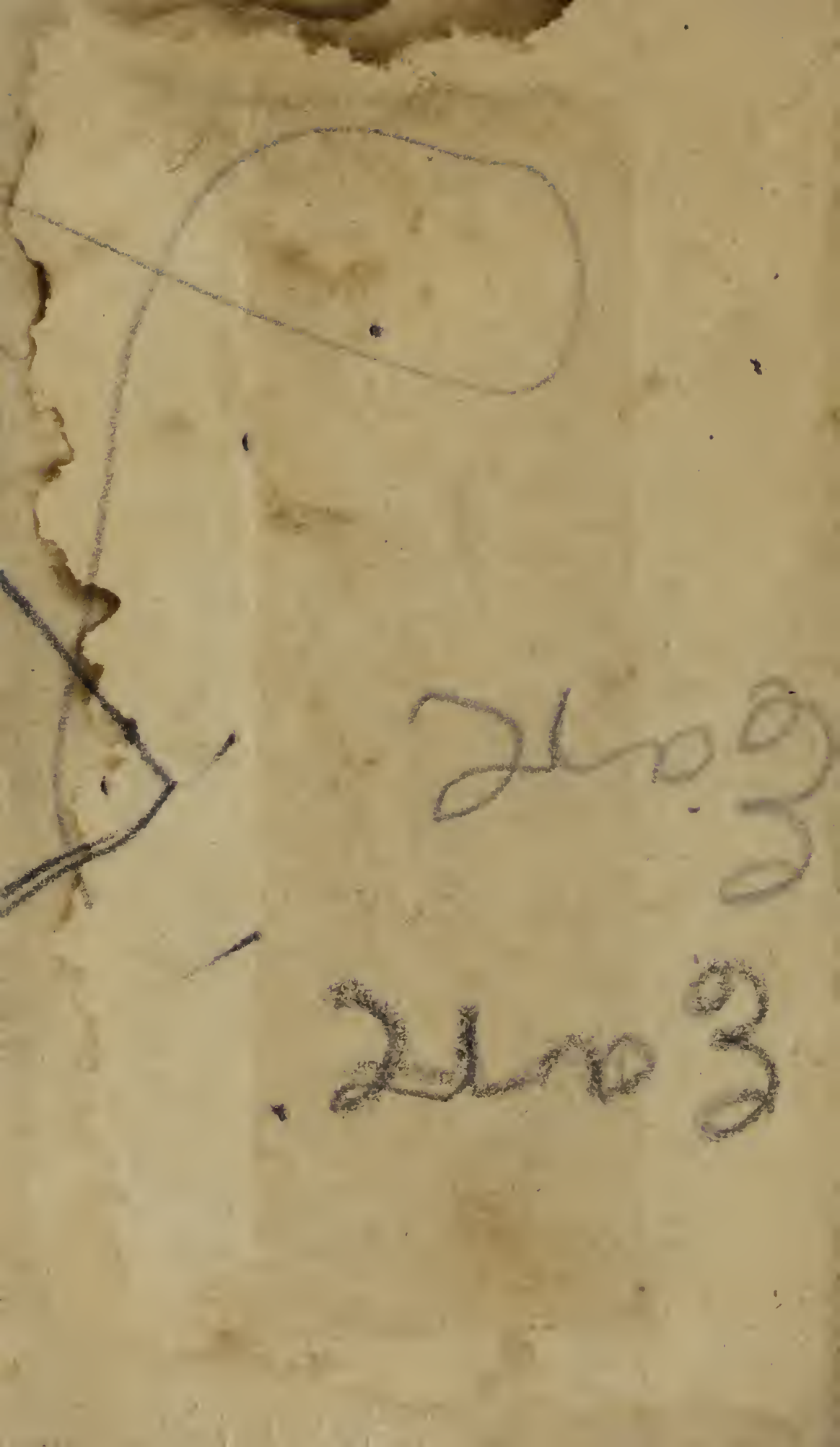
Earl Vaughan



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